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SCIENTIFIC AMERICAN

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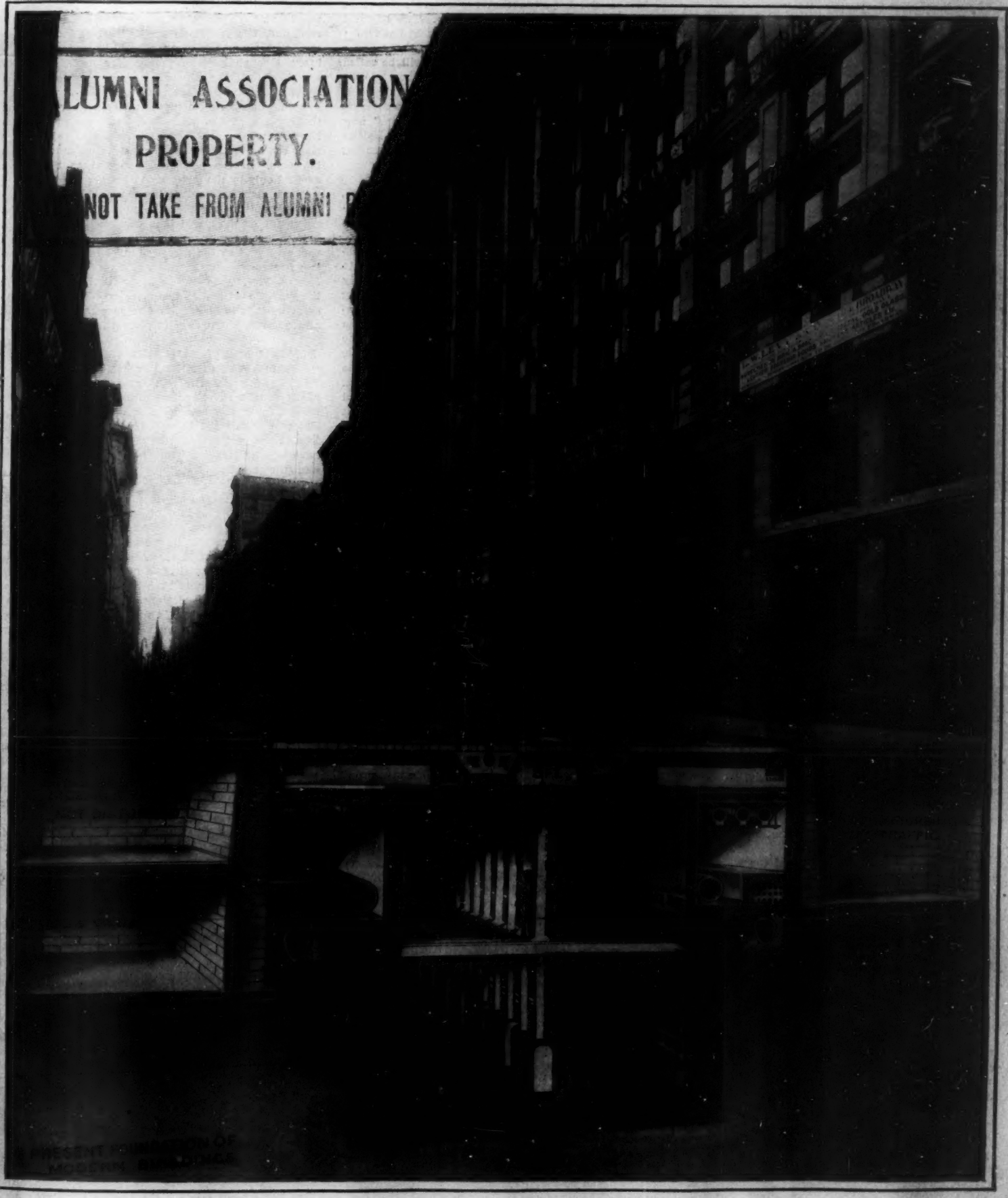
Vol. XCII.—No. 14. ESTABLISHED 1845. NEW YORK, APRIL 8, 1905. 5 CENTS A COPY $3.00 A YEAR.



This system does not interfere with sidewalk vaults; provides room for pipe galleries; and may be used on the narrower thoroughfares.

THE DOUBLE-DECK SUBWAY SYSTEM APPLIED TO BROADWAY, NEW YORK.—[See page 288.]

SCIENTIFIC AMERICAN

ESTABLISHED 1845

MUNN & CO., - - Editors and Proprietors

Published Weekly at

No. 361 Broadway, New York

TERMS TO SUBSCRIBERS

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MUNN & CO., 361 Broadway, New York.

NEW YORK, SATURDAY, APRIL 8, 1905.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

THE OCEAN RACE FOR THE GERMAN EMPEROR'S CUP.

With the recent closing of the entries for the German Emperor's cup, which occurred April 1, this great event, which in point of the size and number of yachts that are entered must rank as one of the most notable events in the history of yachting, begins to attract the attention which is surely its due. There is, of course, nothing new in the idea of a yacht race from Sandy Hook to some point on the English coast. There have been many such races, and the competing yachts were sailed with a reckless hardihood that has placed the records where it will be very difficult to surpass them in this or future races. Take, for instance, the "Henrietta," which, in 1866, made an average speed for the course of 9.36 knots and ran in one day a distance of 280 knots; and also the matchless "Sappho," which three years later made an average over the whole course of 9.66 knots, and ran in a single day 316 knots, a day's run which, however, was surpassed later by the "Dauntless," another famous schooner, which in 1887 reeled off 328 knots in twenty-four hours. This record of the "Sappho" stood until the year 1900, when the schooner "Endymion" averaged for the whole run across the Atlantic 9.66 knots, exactly the same average as that of the "Sappho." The "Endymion," moreover, broke the record for the whole course, which she still holds, crossing from Sandy Hook to the Needles in thirteen days, twenty hours, and thirty-six minutes. This fine run, however, was not made in a race, but in the course of an ordinary passage across the Atlantic, and therefore it stands in a class by itself.

There are so many variable conditions entering into a great ocean race such as this, that it is impossible, even for the self-constituted yachting sharp, to make any predictions either as to the winning yacht, or the speed at which the course will be sailed. Although all of the yachts are large vessels, the smallest of them being 86½ feet on the waterline, there is so much difference in their size, rig, model, and construction that it is futile to hazard a guess as to which boat would be the winner, even if they kept in close company all the way across, which they will not, and even if they should have steady, whole-sail breezes for the whole distance, which is even less likely. At the time of the year when the race will be sailed, the latter half of May, fair weather may be looked for, and in all probability not much reefing will have to be done.

If one were to endeavor to forecast the winner, he would have to prefix his guess with several "ifs" and a "but." We know that length means speed, and that size means ability to maintain headway in rough water; and hence, if winds from abeam to astern prevail, and strong winds at that, we should look to see the huge "Valhalla" lead the fleet into British waters; for with her waterline length of 240 feet, her ample sail spread, and big displacement, she should be able to reel off her 14 to 15 knots an hour with everything drawing. On the other hand, the form of the "Valhalla" is not nearly so fine or sweetly modeled as that, say, of the 101-foot waterline "Endymion" or the 135-foot waterline "Atlantic." This last named, a three-masted schooner, has certain recorded speeds to her credit which should enable her to drop the rest of the fleet in a reaching breeze and a fairly smooth sea.

It is interesting to note that there is one yacht entered in the race, the composite-built yawl "Ailsa," which is a fairly up-to-date racing machine. She was built in 1895 expressly as a competitor against the Prince of Wales's "Britannia," which at that time was sweeping everything before her. She has the light construction, fine model, deep lead, and large sail spread of the racing craft; and if she is so fortunate as to meet with weather that enables her to carry her full sail spread, she should make a creditable showing. The nearest approach to her in fineness of model and relative area of sail spread is the three-masted schooner "Atlantic." And, of course, the extra 36 feet of length of the latter will enable the "Atlantic" to leave the older racing yacht in a breeze of any strength.

From the standpoint of sentiment, interest will naturally center in that veteran yacht, the "Sunbeam," the story of whose wanderings was so delightfully written by Lady Brassey, many years ago. The "Sunbeam" has the length and the lines to maintain a fairly good speed if conditions are favorable. She has proved her staunchness in some of the most lengthy cruises in yachting history, and no doubt she will be able to carry her canvas with the rest of the fleet.

Of the eleven yachts that are entered, five were built in England, and six in America. Two of them will sail under the flag of the Royal Yacht Squadron; seven will fly the flag of the New York Yacht Club; one, the "Thistle" (which, by the way, will be sailed by her owner, Robert E. Tod, and will, therefore, be the only yacht in the race having an amateur skipper), will fly the Atlantic Yacht Club flag; and to a single yacht, the former Watson schooner "Rainbow," now the "Hamburg," which will fly the flag of the Kaiserlicher Yacht Club, will fall the honor of representing the yachtsmen of Germany.

THE DANGERS AND DIFFICULTIES OF TUNNEL BORING.

The joining of one of the twin passages of the 12¼-mile Simplon tunnel on February 24 last—which was fully described in recent issues of this journal and of the SUPPLEMENT—brought to an end most of the difficulties the engineers of that great enterprise had to surmount, and made the completion of the work fairly easy. Never before in the history of land tunneling have such formidable obstacles been met and successfully overcome. Not only was there trouble from cracking and crumbling of the masonry walls by the great pressures they sustained, but also formidable springs of hot water were encountered, which made the temperature unbearable and flooded the workings. These hot springs made the boring of this celebrated tunnel through the Simplon range almost as difficult and dangerous a piece of work as is the boring of the North River and East River tunnels in New York city. Attention was called to this latter work, and the difficulties which attend it, by an accident which happened in the northernmost tunnel under the East River on March 27. This tunnel is being driven from the Brooklyn side of the river. It starts just west of Clinton Street, and has reached a point in the river 1,400 feet away, or about 20 feet beyond the stringpiece at the foot of Joralemon Street and between piers 17 and 18. It is being driven by a tunneling shield similar to that used in 1868 by the late editor of this journal, Mr. Alfred E. Beach, in constructing an experimental tunnel under Broadway. While this shield (with which our readers are doubtless familiar, as we have described it at various times) operates very well in solid earth, it having been used not only for land tunnels, but also for tunnels under water in various places, when it is used near the river bed in soft sand, such as is found in the East River, there are liable to be "blowouts," as they are termed, and these are exceedingly dangerous. As the shield is forced forward through the sand, the latter is kept from oozing in by means of compressed air. If it were possible to carry on the work with the air pressure at the point where it is equal to the pressure of mud and water at the top of the shield, there would be no difficulty; but as the bottom of the shield is nearly 20 feet below its top, a greater pressure than is needed at the top has to be employed in order to keep out the sand at the bottom. The result is that if the sand is not very firm or thick, the excessive air pressure at the top of the shield is liable to make an opening through the river bed and blow out, whereupon, if the air pressure is not maintained, water will flow in. It was just such an occurrence as this that cost the lives of twenty men in 1880, during the first attempt at driving a tunnel under the North River, although at this time work was being carried on without a shield and great risks were taken. The men doing the work in the East River tunnel knew that the river bed was treacherous, and they were provided with sandbags with which to stop up any small leak that might start, before it should have a chance to enlarge. In the accident mentioned, a workman in the upper part of the shield discovered a leak, and called to his mates below to hand up a sandbag. They did this, and he was about to stop up the leak when a large hole was blown through the river bed, and the rapidly escaping air forced the workman up through it and the water above and projected him, in a column of water, a few feet above the surface. He was rescued by men on the pier, and, save for a wetting, was unhurt. The other men in the shield managed to make their escape and shut the doors behind them. One of these men became wedged while making his escape, and it took half an hour to dislodge him. The air pressure meanwhile was kept at the point to which it fell as a result of the blowout. This was only a few pounds lower than the pressure that had been maintained.

In order to resume work, it was necessary to stop up the hole in the river bed. This was done by sinking a large sheet of canvas and loading it with bags of sand. The water was then pumped out of the shield, and work was begun once more. The river bed above the shield is only 8 or 9 feet thick where the accident occurred, and there is about 19 feet of water.

The air pressure in excess of atmospheric used to hold up this weight of water and sand was only just sufficient to balance the pressure of the water and sand at the bottom of the shield, and it caused a few pounds per square inch more pressure than was needed at the top. A bowlder was encountered and blasted a short time before the leak was discovered, and it is probable that the blast so loosened the sand that when the air once started to escape, it easily broke through a large passage for itself, and kept escaping until the air and water pressures became equalized. This accident is an example of what may happen when boring a tunnel under a river and near the surface of the river bed. In constructing the North River tunnel, it was necessary to thicken the river bed on the line of the tunnel, in order to prevent blowouts. In the present instance these have been avoided only by the greatest vigilance.

The system of constructing a tunnel from the surface by putting together the upper half, sinking it, placing it on piles, and then constructing the bottom half on a concrete foundation beneath—a system which was employed in the subway tunnel beneath the Harlem River successfully, and which we described in our July 2, 1904, issue—does away with the dangers we have mentioned and is also more expeditious. We understand it is to be employed in constructing a tunnel across the North River at 42d Street in the near future.

ELECTRIC STREET RAILROADS VERSUS MOTOR-PROPELLED VEHICLES FOR PASSENGER TRAFFIC.

During the past two or three years the conversion of the various street surface railroads in Great Britain to electricity has been carried out very extensively. But now a halt has been called in this development. During the past few months innumerable experiments have been carried out with motor-propelled omnibuses and the results have been somewhat remarkable. From these experiments it is evident that this type of vehicle and means of propulsion has been brought to the requisite standard of efficiency and reliability for this class of work. There are several motor omnibus services already being maintained in various parts of the metropolis, and as they have been introduced in competition with the electric railroads, some interesting comparative results have become available. From this it is conclusively demonstrated that for all-round work the motor vehicle is far more satisfactory, especially in crowded thoroughfares. In the first place, while its speed may not be so great as compared with what the electric vehicle running on the railroad can attain when the road is clear, yet, owing to its greater mobility, it can thread its way in and out of the other traffic with greater facility. It has been shown on numerous occasions that when the two types of vehicles have started from one point for another distant station, the latter has been reached by the motor omnibus in the shorter time. In one instance the motor omnibus service is able to maintain an average speed of 12 miles an hour through ordinary thoroughfares, whereas the electric car has only been able to average a speed ranging from 7 to 9 miles per hour.

At the present moment there are 162 motor omnibuses in course of construction for the various companies of London, which number, in the course of the next two years, is to be increased to 1,000. These vehicles cost on the average $4,000 apiece and have accommodation for 34 passengers. One of these 'buses has just completed a 2,000-mile reliability test. The vehicle is propelled by a four-cylinder motor developing 24 horse-power. The average daily run was 100 miles, the total weight of the car when loaded representing 5 tons. On average roads a speed of 16 miles an hour was maintained. The longest run made without any involuntary stop was 971 miles, which, considering the fact that no overhauling, cleaning, or other adjusting work was permitted upon the vehicle during the whole time, is in every way satisfactory. The gasoline consumption throughout the whole 2,000 miles aggregated 297 gallons, representing an average of approximately seven miles per gallon. Another important point in regard to these vehicles is their economy in operation as compared with their earning capacity. A motor vehicle running 700 miles per week can earn on the average from $250 to $350, while the working expenses for the same distance and period aggregate only $90.

At the present moment the London County Council are converting the whole of the surface railroads under their control to electric power. In one district, owing to the advance of the gasoline vehicle, the scheme of

electrification, however, has been abandoned. It is estimated that to convert the section in question to electricity over $9,000,000 would have to be expended. The existing railroad would have to be torn up, heavier rails laid down, and the conduit for the accommodation of the current cable and collecting shoe installed, while special vehicles would have to be constructed.

Instead it is resolved to allow the existing rails to remain and to supersede the present horse-drawn vehicles by cars equipped with oil or gasoline motors. By this decision the expense will be simply confined to the purchase of the motor vehicles, which will cost approximately from $4,000 to $5,000 each. No expensive generating plant, stations, and transformers or cable will have to be laid down, such as would be the case were electricity adopted.

The electric conversion of street railroads in London especially is being brought to a stop owing to the rapid strides of the motor-propelled vehicle. The majority of engineers interested in the project are realizing the fact that as electricity has superseded steam so the internal combustion motor system of propulsion is rivaling electric motive power, and there is no doubt that within a very short time the motor vehicle for all-round street service will largely replace the electric trolley car.

While the gasoline omnibus may prove to be even more economical than the electric trolley car, there is little doubt that a large number of these machines running in the city streets would greatly vitiate the atmosphere, owing to incomplete combustion and the burning of lubricating oil. That this will eventually become a problem with private automobiles may be appreciated by any one who sees a high-powered machine emitting clouds of smoke as it moves through the streets. Therefore it would seem as though the New York Transportation Company was taking the right course in adopting electricity as the motive power of the new thirty-passenger 'buses it expects to be operating soon on Fifth Avenue. In this city most of the commercial vehicles are electric, even to the heaviest trucks; and in the present state of the storage battery, these are operated at a saving over horse-drawn trucks. Therefore the new electric autobuses will doubtless prove profitable, besides giving New Yorkers clean, cheap, and rapid transit on one of the principal avenues in which the transportation facilities have always been wofully poor.

AN ANTITOXIN FOR LAZINESS.

BY HUGO ERICHSEN.

If the conclusions drawn from experiments detailed in a recent issue of the Muenchener Medicinische Wochenschrift (No. 48, vol. 51) are substantiated, fatigue and exhaustion will be a thing of the past. To banish sleepiness, it will only be necessary to drink an antitoxin (a substance that renders a toxin or poison inactive), which will invigorate you, no matter how jaded you may be. Henceforth such a thing as a somnolent policeman will be unknown on the force, and the speed of the messenger boys will only be comparable to that of the winged Mercury himself. Women who are fond of talking will be able to enjoy their gossiping proclivity to the full, and renew the flagging interest of their victims with an occasional hypodermic injection of the new stimulant. Factory and office employes will lead a strenuous life indeed when the vigilant inspector makes the rounds with a syringe full of the new serum, so called after one of the fluid constituents of the blood from which it is derived. Indeed, when one comes to think of it, the application of this marvelous discovery would be almost illimitable. Race horses, sustained by the antitoxin, would be sure to win, armies enabled to endure forced marches in order to snatch victory from the jaws of defeat, and worshipers prevented from falling asleep in church during a dry sermon and suffering the consequent disgrace. Possibly at some time in the remote future, it will become customary to politely offer a fellow mortal a dose of antitoxin, whenever he yawns or exhibits any other sign of weariness, much as a pinch of snuff was proffered, as a matter of course, in centuries past.

But, seriously, if we believe the eminent authority mentioned, Dr. Wolfgang Weichardt, of Berlin, has made a very important contribution to the science of physiology, a discovery that is destined not only to be of service to acrobats but in the treatment of neurasthenia, better known as nervous exhaustion, and the convalescence from acute diseases. Briefly, his experiments may be described as follows: A guinea-pig was drawn backward, on a rough carpet, by means of a string, until it no longer resisted interference with its motion and was totally exhausted. Stimulation was continued, by means of electricity, until the animal was in a state of autointoxication, that is to say, a condition of infection from the toxin or poison generated by itself. During the experiment, the temperature of the guinea-pig fell from 39.2 to 34.8 deg. Celsius. When exhaustion could be carried no further, the animal was killed. Immediately after death, the toxin (or poison) was obtained from the crushed muscles of the animal. When dried in a space exhausted of air, the toxin was found to consist of yellowish-brown scales, that were not very stable and had to be kept in sealed glass tubes, preferably in liquid air. This toxin or poison, injected into other guinea-pigs, produced symptoms of exhaustion followed by death within twenty-four hours. The same poison could not be obtained from the muscles of non-exhausted animals.

Weichardt's antitoxin is produced very much like that of diphtheria, by injecting the toxin into the circulation of horses. When dried in a vacuum, the resulting scales—unlike those of the toxin—are permanent; in fact, the substance retains its activity even after months. It is readily taken up by the stomach, but generally injected under the skin by means of a hypodermic syringe. It was determined that ten milligrammes of the toxin are neutralized (or rendered inactive) by one-tenth of a milligramme of the antitoxin. Small animals, into which the toxin was injected, remained in a perfectly normal condition when treated with the antitoxin, but succumbed to the poison when the antitoxin was not administered. After taking four doses of a quarter of a gramme of the antitoxin, in pastilles, a young lady was able to lift two kilogrammes 2,478 meters with the middle finger of her right hand, whereas she had only been able to lift the same weight 1,533 meters alone. The ingestion of the antitoxin did not produce any disturbance whatsoever; on the contrary, it was followed by increased vigor and energy. Dr. Weichardt's findings are based upon a large number of experiments.

TURBINES VS. RECIPROCATING ENGINES IN MARINE SERVICE.

BY OUR ENGLISH CORRESPONDENT.

Although the Parsons marine steam turbine is being extensively adopted in Great Britain for the propulsion of vessels, yet for the most part this application has been based upon the theoretical advantages of this system over the ordinary reciprocating engines. Now, however, actual comparative results of the two methods of propulsion are available, since statistics and data have been gathered during the day-by-day commercial use of the marine turbine in competition with the older form. These results abundantly justify the confidence entertained by the inventor in this system.

In June, 1901, the first turbine-propelled vessel intended for commercial traffic made her trial trips. This was the vessel "King Edward," which was built for the service between Greenock and Campbelltown on the River Clyde, and was maintained in service by the syndicate especially formed to prove the efficiency of the Parsons turbine for such work. This syndicate comprises the Parsons Marine Steam Turbine Company, of Wallsend-on-Tyne, Messrs. W. Denny & Sons, the well-known shipbuilders of Dumbarton, and Capt. John Williamson, to whom we are indebted for much of the information contained in this article. The "King Edward" was duly described, together with the results of the trial trips, in the SCIENTIFIC AMERICAN at the time. In general design the "King Edward" is similar to the existing vessels engaged in this class of traffic, being 250 feet in length by 30 feet beam, and depth to promenade deck of 17 feet 9 inches. The vessel is equipped with three sets of Parsons turbines—two low-pressure and one high-pressure—capable of developing a speed of 20 knots per hour. So satisfactory were the results with this vessel, that another ship of somewhat larger dimensions—"Queen Alexandra"—was built for the same service.

These two vessels have now been running for four and three seasons respectively. Recently the turbines of each vessel were opened, and no perceptible wear and tear on the machinery was found. The turbines were as bright and as clean as the day when they left the builders' shops. There is so little oil used in connection with the turbines that the boilers are kept thoroughly clean, and consequently this adds considerably to their life. The total amount of oil used per month is the low average of about one gallon. Of course, oil is employed for the auxiliary engines, but this factor is not considered in the present calculations.

In some quarters it is maintained that owing to the high speed at which the turbines revolve, the repair bill must be unduly heavy. But this contention is not supported by actual work. So far as the "King Edward" is concerned, the extent of repairs is so trifling as not to be worth consideration, being confined to the refilling of the bushes once or twice.

It is also urged against the turbine that there is an abnormally heavy consumption of coal involved in maintaining the high speed developed as compared with the amount required to develop the maximum power with a reciprocating engine. On this point there is a great diversity of opinion, but Capt. Williamson, who superintended the operation of these two turbine vessels, has prepared some interesting tables on this point, which are rendered additionally valuable since he is able to offer comparative data concerning this problem. The vessel which he has utilized for comparative purposes is a vessel in every respect similar to the "King Edward." The dimensions and tonnage are identical; the boat is quite modern, and is fitted with the most up-to-date type of reciprocating engines. The vessel furthermore is employed in similar traffic to that in which the turbine vessels are engaged. These comparisons are as follows:

	Turbine steamer.	Steamer with reciprocating engines.	Turbine steamer.	Steamer with reciprocating engines.
	1901.	1901.	1902.	1902.
Speed on trial trip	20½ knots	18 knots.	20½ knots.	18 knots.
Mileage	12,116	15,604	15,605	14,860
Coal consumption	1,429 tons.	1,758 tons.	1,897 tons.	1,744 tons.
Days sailing	79	111	110	105
Mileage per ton	8.47	8.87	8.37	8.51
Average coal per day	18.2 tons.	15.17 tons.	17.5 tons.	16.6 tons.
Working average per hour	8½ knots.	16 knots.	18½ knots.	16 knots.

From this it will be observed that there is very little difference between the mileage per ton of the two types of vessels. But at the same time, the fact must not be overlooked that the difference in speed is 2½ knots per hour in favor of the turbine boat, which represents a considerable increase. Further comparison on this point is afforded by comparison with another river steamer of a similar type and driven at the same average speed, fitted with reciprocating engines. The results are as follows:

	Steamer with reciprocating engines.	Turbine steamer.
Distance steamed	12,106 knots.	12,116 knots.
Days sailing	80	79
Daily average speed	18½ knots.	18½ knots.
Coal consumption	1,909 tons.	1,429 tons.

The efficiency and economy of the turbine vessel are even more decisive in this case. Not only did it cover a greater distance, by 10 knots, than that recorded by the other vessel, but the coal consumption, even including the slightly increased mileage, shows a balance of 480 tons in its favor. It may be pointed out that the above service speed of the "King Edward" represents about two-thirds of full power on trial. For the past two seasons the economy of the two turbine vessels is equally well marked, though in the case of the "Queen Alexandra," which is of greater dimensions and speed than her consort, the results show an even better record.

An exception may be taken to the comparison of the above-mentioned steamer fitted with the ordinary reciprocating machinery; it may be explained that she is fitted with compound engines. The builders state, however, that if she were equipped with triple-expansion engines, the coal consumption could be reduced; but even under these advantageous conditions, to maintain an average speed of 18½ knots per hour would involve a coal consumption of 22 tons per day, which is four tons in excess of that required by the turbine steamer to maintain the same average speed, corresponding to an economy of 20 per cent in favor of the turbine steamer.

In connection with the foregoing results, however, there is one prominent fact that must not be overlooked. To obtain the maximum efficiency and economy of the turbines, they must be driven at full pressure. The maximum speed of these Clyde vessels is 20½ knots, while in the above comparison their speed is only 18½ knots. At the latter speed, therefore, they are less economical than they otherwise would be. With these particular vessels, however, this difference is not so very marked. The deficiency in economy when running at a lower speed than that for which they are designed is more emphasized in the case of war vessels, where for the greater part of the time a cruising speed only is required. In strictly commercial vessels, the opposite is invariably the practice—full speed, that is, running at the designed power of the turbines, with a minimum of reduced speed. In the aggregate, therefore, the loss in economy is very slight. In the case of the "King Edward," practice has demonstrated that it is necessary to reduce the speed of the vessel to between 17 and 18 knots before ordinary engines under similar conditions and at the same speed show a less fuel consumption per knot of speed. This 17 or 18 knots speed corresponds to about 50 per cent of the total maximum power of the turbine engines of the "King Edward." Up to the highest speed at which this vessel has been driven, an always increasingly favorable consumption of coal in proportion to the speed of the vessel has been found.

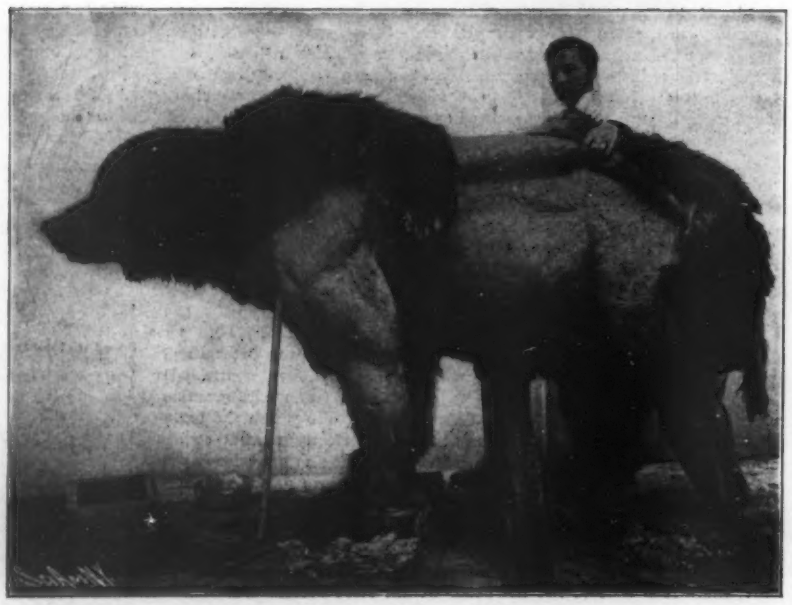
One noticeable feature in connection with these two turbine vessels is the regularity of their running. In no instance has the daily service of either craft been interrupted. No breakdowns have ever occurred, nor has there ever been the slightest hitch. In fact, it has been possible to maintain a better daily service on the River Clyde than has hitherto been possible.

THE LOFTY PECOS VIADUCT ON THE SOUTHERN PACIFIC RAILWAY.

BY DAY ALLEN WILLEY.

The traveler on the Southern Pacific Railway between New Orleans and California crosses one of the most notable viaducts in the world. This is a bridge which spans the Pecos River. A few miles from the point where it flows into the Rio Grande, the Pecos passes through a canyon which is directly on the route of the railway in question. In addition to the height of the canyon walls another problem which the engineers had to solve was the flow of water during the season when the river is in flood. Frequently the volume of water carried down is so great that in twenty-four hours the river may rise to a height of from 20 to 30 feet. The plan decided on was a bridge supported by steel towers, the center towers resting upon piers of masonry which would place the footing of the steelwork at a height above the ordinary freshet. As the photograph shows, the cantilever system of construction was employed to bridge the full width occupied by the river when it is in flood. At the greatest elevation the rails are no less than 321 feet above the water. In fact, the only viaduct in North and South America which exceeds the Pecos is the Loa in the Andes Mountains. This is 336 feet high, but only 800 feet in length, less than half the length of the Pecos, which is 2,180 feet from end to end. The structure which crosses the Kinzua Creek in Pennsylvania on the route of the Erie Railway is next in height in the United States—301 feet—but is slightly shorter, being but 2,053 feet in length. The famous Gokteik bridge recently completed in Southern Asia is but 320 feet high, although it is about 100 feet longer.

Considering its dimensions, the Pecos viaduct is an exceedingly light and graceful structure, containing but 1,820 tons of metal in all. The heavy trains of Pullman cars, with the two big passenger locomotives at the head, will weigh about 860 tons, or nearly half as much as the whole bridge. The great height can be estimated by noting the size of the locomotives and cars, as they are seen from the bottom of the canyon. The bridge is situated in Val Verde County, Texas, and is 219 miles west of the city of San Antonio.



DRAWING THE BEAR'S SKIN OVER THE MODEL.

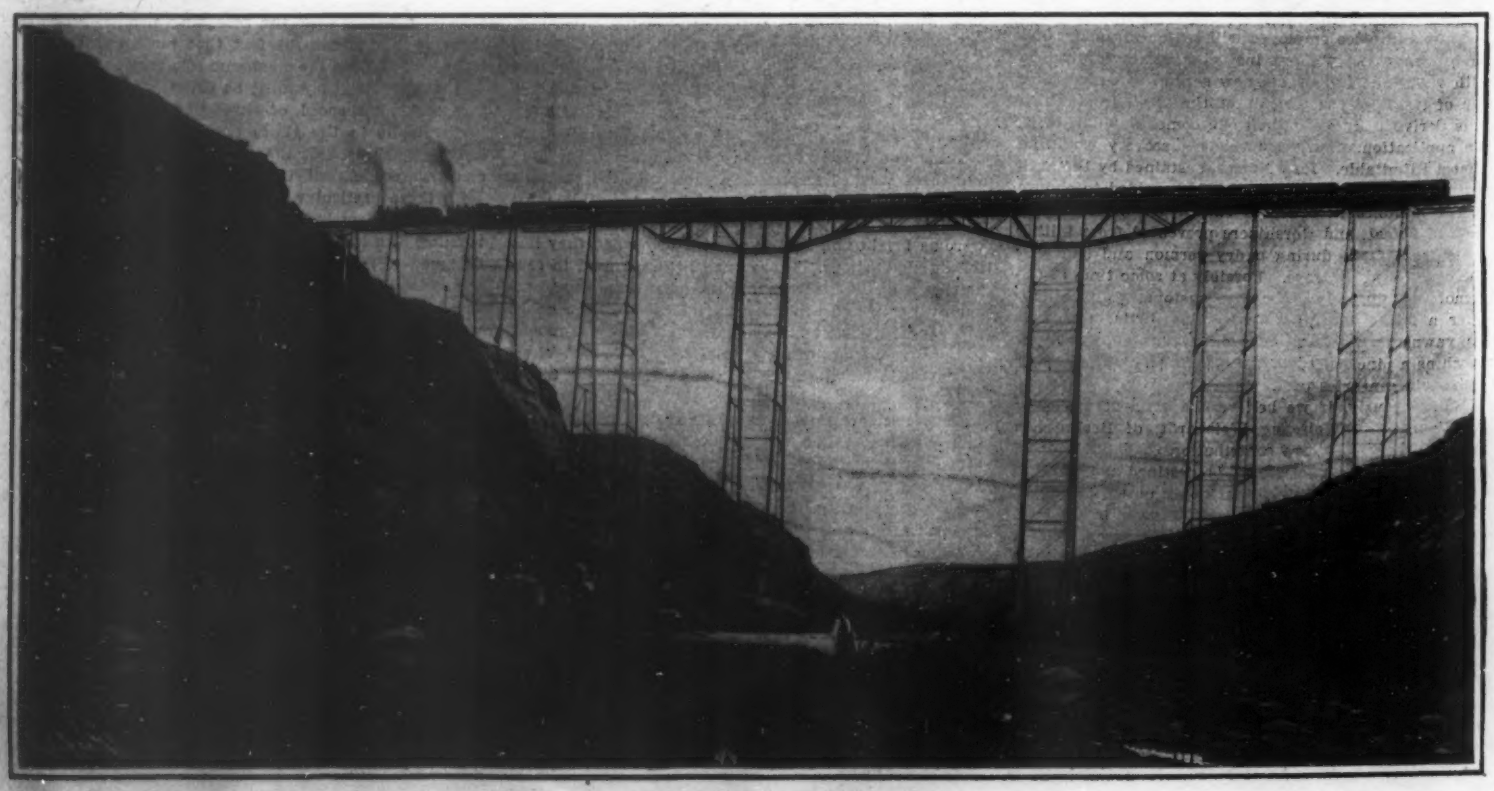
MOUNTING THE LARGEST BEAR EVER KILLED. WEIGHT 1,600 POUNDS.

THE LARGEST OF BEARS.

The record-breaking bear of the world has been brought down. This magnificent natural history prize, and one of the greatest specimens of wild animal life which has reached civilization, will shortly be installed in Prof. J. A. Allen's Department of Mammalogy in the American Museum of Natural History, New York. This leviathan was secured by the Museum's 1903 expedition under the leadership of Mr. Andrew J. Stone, who was sent to Alaska and northern British Columbia to secure Arctic mammals and birds for the museum. The funds for these hunting explorations in the Far North were provided in 1901 through the generosity of several friends of the institution.

Three expeditions were made in all, the results being that the museum has now acquired the finest series of the large game animals of sub-Arctic America in existence, besides several thousands of small mammals, representing abundantly nearly all the species of the regions visited. Fine specimens were obtained for groups of the big Alaska brown, black, and grizzly bears, the great Alaska moose, two species of caribou, two of the mountain sheep, mountain goat, and the Sitka deer. Among the small mammals, several entirely new species were discovered and others previously little known were secured, besides a large number of birds. The round-up of the hunt of 1903, the last of the expeditions, numbered 873 forms, including about thirty large mammals (moose, sheep, bears, etc.) representing 28 species. About 140 were collected on the Bering Sea side of the Alaska Peninsula, near Muller Bay, and the remainder on the Kenai Peninsula.

The principal trophy, aside from its scientific importance, and one destined to attract widespread attention among all big-game lovers and sportsmen, was the great male bear, *Ursus dalli gyas* Merriam, measuring 8 feet in length and 4 feet 4 inches in height at the shoulders, and weighing approximately 1,600 pounds. Mr. Stone, with four experienced hunters, two Indians and two white, made a special bear hunt in May, 1903, in and around Muller Bay. On the 29th the big creature was shot, affording his captors an exciting and somewhat dangerous experience. Ten fine examples of large brown bears obtained by Mr. Stone at Muller Bay throw much light on the question of the number of species of bears on the Alaskan Peninsula. Of these specimens nine belong to the form *Ursus merriami* and one to *Ursus dalli gyas* Merriam, based on specimens from Pavlof Bay, on the opposite side of the peninsula from Muller Bay. The two species proved to be read-



Height of rails above water, 321 feet. Length of bridge, 2,180 feet.

THE LOFTY PECOS VIADUCT ON THE SOUTHERN PACIFIC RAILWAY.

ALUMNI ASSOCIATION
DO NOT REMOVE FROM READING ROOM.

ily distinguishable by both cranial and external characters. The big creature has just been mounted in Dr. Dahlgren's Department of Preparation, by Mr. Clark, employing the clay and sculpturing method, previously described in detail in this paper by the writer, of which Mr. J. F. Ackerly, of the Field Columbian Museum of Chicago, is the originator. Huge Bruin will be the dominant figure in a family bear group, showing the female and several cubs in characteristic lifelike positions. Mr. W. H. Osgood, of the Government Biological Survey, who made a recent trip to the same regions, gives some interesting accounts from personal observation of those obtained from native hunters as to the habits of these bears. Probably the most ingenious is that of capturing salmon for food. This is done as follows: As soon as the salmon begin to enter the streams, Bruin makes fishing his chief business. The fish in large numbers usually ascend the streams for the entire summer, and the supply is practically unlimited. In fishing the bears do not get all their prey in shallow water, small streams, or on bars, as is generally supposed, but often go into comparatively deep water in large rivers. Practically all the fishing is done at night or very early in the morning, though their habits in this respect have become somewhat changed in recent years, since they have been hunted so much. The cubs do not attempt to fish, but stay on the bank and receive contributions. The old she-bear stands upright and wades in the water even up to her neck, going very slowly with the current, watching the water and scarcely making a ripple in it. She holds her arms down at her sides, with the paws spread, and when she feels the salmon coming up against her, clutches it with her claws and throws it out on the bank to the eager waiting cubs. After supplying her offspring she puts the next fish in her mouth and goes ashore to eat it. If a plentiful supply has been obtained, only the choice parts are devoured, such as the two sides, leaving the rest. The cubs, however, are not so particular, and consume their whole portion. The accompanying photographs, taken by the writer, are the first made of the subject, and are reproduced through the courtesy of the American Museum of Natural History.

THE "VICTORIAN," THE FIRST TURBINE ATLANTIC LINER.

The "Victorian" is the pioneer turbine vessel to be placed in the transatlantic service and, as such, her arrival in America is an event of more than ordinary interest. Turbines have proved a success for small high-speed channel steamers, but whether they would be an equal success for the largest ocean steamers remained to be proved. The transatlantic trip of the "Victorian" practically solves this problem.

The "Victorian" on the Ways.

The "Victorian's" Turbines in Course of Construction.

The Rotating Member of One of the Turbines.

THE "VICTORIAN," FIRST TURBINE LINER TO CROSS THE ATLANTIC.

The "Victorian" was launched from the shipbuilding yard of Messrs. Workman, Clark & Co., Ltd., Belfast. Her length is 540 feet; her breadth, 60 feet; her depth, 40 feet 6 inches. She is divided by bulkheads into eleven compartments, and with the subdivisions of her double bottom she is amply secured against foundering. She is built to the highest class of the British Corporation Registry of Shipping, and her hull has been specially strengthened above the requirements of the corporation, in order to make her doubly secure against the heavy weather of the North Atlantic. Her lines fore and aft are sharp and clean, swelling gracefully into a noble breadth amidships, which suggests high qualities of steadiness and stability.

Originally the "Victorian" was designed to be driven by reciprocating engines, but ultimately Messrs. Allan decided that she should have turbines instead. The builders made the necessary alterations in her structural design, and at the same time undertook what was a far more difficult task—the construction of the turbines, the largest ever made, which drive her. This was by arrangement with Messrs. Parsons & Co., for [illegible] Parsons turbine that was decided upon. [illegible] high-pressure and two low-pressure turbines drive the three propellers of the ship, which by this [illegible] drive a ship possessing a cargo capacity of more than 8,000 tons, besides [illegible] tion and equipment for upward of 1,300 passengers. These propellers, however, revolve at from 270 to 300 revolutions per minute. The central one is worked by the high-pressure turbine, the others by the low-pressure turbines. Shafts of the two latter carry also a reversing turbine, which enables them to be driven full speed astern, either together or independently. Thus the ship will be almost as easily and effectively maneuvered as regards turning or backing as an ordinary twin-screw. The steam economy of the turbine has been amply established; but economy of the coal supply is not the only advantage which the turbine promises in connection with ocean traffic. There is a complete absence of the unbalanced forces which cause vibration in an ordinary steamer, and which is thus reduced to the vanishing point. Then there is very little fear of breakdown, because there are no reciprocating parts to break or get out of order. It is usually the breaking of a crankshaft, or connecting-rod, or some such appliance that causes trouble on a modern steamer. Here the steam acts directly, driving the shafts of the ship with an even turning movement, enormously reducing the stresses to which the moving parts of ordinary engines are subjected.

The steam to drive the turbines is generated by eight boilers of the usual type. The turbines were constructed in an engine shop specially equipped with the necessary plant. The turbine blades are surpris-

ingly small; their number, however, is prodigious, there being no less than a million and a half separate pieces used in the blading of the three turbines. It is the enormous amount of time, care, and labor required in making and fitting these blades that render the turbine so expensive to build.

On her trial trip the "Victorian" made over 19 knots. Thanks to the economy of space, the builders have been able to provide accommodation on board the "Victorian" such as is probably not to be equaled by any vessel of her size afloat. They have utilized the saving, not to increase the number of passengers carried, but to give every possible comfort and luxury to all three classes of passengers. The "Victorian" will be emphatically a comfortable ship so far as perfection of appointment can make her so. Care for the humble steerage passenger has always been a leading point of policy with the Allan Line. For the "Victorian" it is exemplified in a remarkable degree. The music room, the dining room, and other special accommodation for this class challenge admiration for their roominess and completeness of equipment. The first-class accommodation, as usual, is amidships and is of the most complete and approved order. Perfectly heated and ventilated staterooms and suites of rooms, a spacious and well-fitted dining saloon, an elegantly-appointed music room, and a luxuriously-equipped smoking room are some of the features. Not less comfortable proportionately are the second-class quarters; and, as already indicated, third-class passengers are catered for in the most liberal manner. Electric light throughout, a complete printing outfit, and an installation of wireless telegraphy are among the arrangements for the comfort and convenience of passengers.

MINIATURE CAMERAS.

BY EDWARD P. CHANDLER.

Most of us have seen small cameras. In fact, comparatively small ones are to be found upon the market. Upon close examination, however, we find that the smallest box-camera fitted with finder, shutter, stops, and diaphragm is rather cumbersome to carry in the pocket. If it were not quite necessary to have a finder and the rest of the accessories, we would probably have little difficulty in locating some very small cameras of the pin-hole type, which make very unsatisfactory instruments for anything but experiment. In the current Scientific American Supplement will be found a full description, with working drawings, of a method of making very efficient diminutive cameras. This article is an abstract of the account there published.

Referring to the illustration, we have two cameras photographed upon a man's hand so as to show their relative sizes. The smallest one in the picture, the outside measurements of which are 1¼ inch by 1¼ inch by 1⅝ inch, requires only a brief description, as it is merely a single-exposure camera, having few of the necessary features that go to make up the practical instrument. This little camera will take a picture ⅝ inch by ⅝ inch, and is provided with a disk shutter set for instantaneous exposures.

The larger camera shown in the photograph is quite complete in every detail, and is capable of turning out work, I feel safe in saying, commensurate with the skill of the operator. This camera takes 25 pictures upon a film ⅝ inch wide, made by cutting a conveniently wide commercial film into strips. This stripping process has to be done in the dark room, and is best accomplished by using a sharp knife, cutting against glass, the knife being guided by a metallic-edged rule.

It may not be out of place to say right here that my best negatives were obtained by using a weak developer and by suspending the film in a red bottle, which allowed me to view the film during the developing process, by holding the bottle up to the sunlight. The fixing, too, was conveniently performed in a wide-mouthed bottle. The hypo bottle need not be colored.

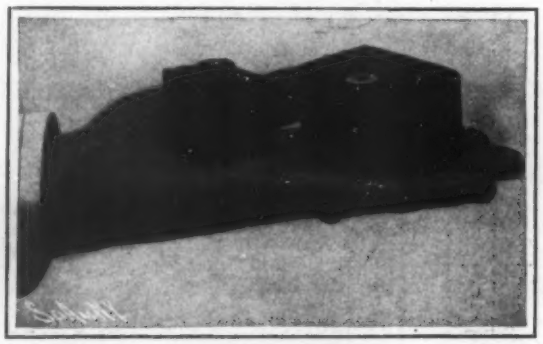
Liquid Fuel for Furnace Equipment.

BY W. H. BEST.

For many years liquid fuel has been successfully used in the heating of iron, especially in forges for the heating of rivets in boiler shops and structural work. These furnaces are of proportions adapted for the sizes of rivets to be heated, and many are portable. In boiler shops liquid fuel has been found to be far superior to coal for fuel, not only in furnaces for heating rivets, but also in large furnaces for sheet and annealing purposes, because large furnaces can be heated so quickly and evenly that there is no comparison between this and other fuels. For the past five years on the Pacific coast, where liquid fuel is abundant, extensive experiments have been made to use crude oil as fuel in blacksmith shops in place of the ordinary blacksmith coal or coke. The tests have been highly satisfactory, and this fuel has proven to be superior to every other fuel because, first, the welds are perfect, as there is no corrosion of the metal, as is the case with coal or coke fuel; second, the iron is made more homogeneous; and third, the output of the shop is greatly increased. A small oil furnace can be constructed at a very small cost without skilled labor, in which a blacksmith can heat several pieces of iron or steel at the same time and can turn out the same amount of work with one oil furnace as can be turned out by five ordinary coal forges, because the iron is always waiting on him instead of his being compelled to lose so much time making the fires and waiting on the iron to heat, as is the case when coal is used in forge work.

It is because of this increased output, and because of the superior quality of metal produced, that liquid fuel is fast becoming a potent factor in the manufacturing world; and when we look upon the various fuels from the thermo-chemical standpoint, it is surprising that the world has been so slow to recognize the value of the new fuel. California crude oil contains 20,680 British thermal units (B. T. U.) per pound; Texas crude oil contains 19,060 B. T. U. per pound; while gasoline contains 14,200 B. T. U. per pound; and coke contains 13,500 B. T. U. per pound. Bituminous coal averages 13,180 B. T. U. per pound, but there is a two-fold loss with this fuel: First, because heat is required to liberate the gases; and second, many of the volatile gases it contains are wasted by their passing away in the form of smoke. Combustion is the energetic unity of the oxygen of the air with some combustible. The air necessary for combustion gives out its oxygen to the hydrocarbons, changing them from carbonic oxide (carbon monoxide) to carbonic acid (carbon dioxide), which is the product of complete combustion. Liquid fuel when thoroughly atomized delivers its hydrocarbons freely, thus allowing the volatile gases to mingle with the oxygen of the admitted air, and this fuel has a decided advantage over coal, in that coal requires heat and time for the decomposition necessary to free the hydrocarbons.

While at present there are sections in the United States where crude oil is expensive and difficult to obtain, yet developments are rapidly advancing, and oil is being found in many parts of our country and in Canada and Mexico in localities where a few years ago the inhabitants would have laughed at the mere suggestion of there being any oil in their neighborhood. When we consider that forty gallons of crude oil are equal to one ton of coal in blacksmith practice, and the increased output of iron or steel effected by its use, as well as the economy in time and labor, because this fuel does not have to be handled and there are no ashes to be disposed of, the price of fuel is scarcely worthy of consideration. In manufacturing centers coal tar and oil-water-gas tar are obtainable at small cost, and may be used where oil is scarce. They are valuable fuels in that they contain greater heating properties than either coal or coke. Tar from coke ovens contains 16,263 B. T. U. per pound, and tar from oil-water-gas contains 16,970 B. T. U. per pound.



MINIATURE CAMERAS.

Although crude oil contains more heat units per pound than any other fuel, yet the results obtained depend largely upon the method of equipment. Properly-constructed furnaces and perfect atomization of the fuel are essential features for success. Thousands of furnaces are daily being operated at a serious loss to their owners, who are wholly ignorant of their great loss in both output and fuel. Of all the poor constructions in the shop equipment in large or small plants for marine, railroad, and contract work, furnaces are the most prominent; and strange to say, often the officer in charge of the department thinks his furnaces are ideal in construction. Often liquid fuel is tried in furnaces and condemned, when the fault lies not in the fuel itself, but in its application. I have met many competent officers who stated that a welding heat cannot be obtained with this fuel, because they had not considered the heat values of the several fuels; but after they have once seen it properly applied, they are delighted with it, and become staunch admirers of the new fuel.

A furnace constructed for the burning of coal as fuel requires various changes to meet the requirements of liquid fuel, but these changes can be made at a slight expense, as the body of the furnace need not be altered. With the requisite changes made, any degree of heat desired, from a cherry red to a welding heat, can be attained in much less time than with coal, and an almost incredibly even distribution of heat maintained, because radiation is perfect, and hence the metal is evenly heated. An oil furnace should be of such design that the oxygen can so unite with the atomized fuel that an incandescent heat and not flame is seen in the charging space of the furnace. A box-shaped oil furnace means a waste in fuel, a decreased output, and disappointment to the owner and operator.

Oil furnaces and forges can be constructed to meet the requirements of the class of work without regard to the shape of forging to be handled. In the blacksmith shop of the Bureau of Construction and Repair of the Norfolk navy yard, not one pound of coal or coke is used, for here liquid fuel has proven its superiority over all other fuels for all classes of work; and certainly in marine service the requirements as to the quality of metal are as severe and the forgings are as intricate to heat as in any other branch of service. In furnace practice compressed air should always be used to atomize the crude oil, distillate, or tar used as fuel, as it assists combustion, effects a saving in fuel, increases the output, and also increases the life of the refractory lining of the furnace. When compressed air is not convenient, steam may be used to atomize the oil, and a volume blast of air produced by a fan blower or a rotary blower should be admitted into the furnace to furnish the oxygen necessary to effect combustion.

A hydrocarbon burner of such construction that it will thoroughly atomize the liquid fuel by dashing every drop of it into ten thousand molecules, and which will produce a flame that will spread the full width of the modern oil furnace, and thus give the necessary reverberation, should always be used. Some people attempt to economize by making a burner out of gaspipe, but after sixteen years' experience with liquid fuel in marine, locomotive, and stationary boilers and in various kinds of furnaces, I am compelled to term such burners dismal failures, because such contrivances do not and cannot atomize the fuel. The quantity of fuel used through the burners should be carefully regulated, for a superfluous amount of hydrocarbons in the furnace means a waste in fuel and is detrimental to the materials being heated, while not enough of the hydrocarbons means a superfluous amount of air and oxidation of iron. All oil forges and furnaces used in blacksmith shops should be of such construction that only one burner will be required, for a blacksmith can regulate a modern oil furnace equipped with one burner very quickly and so perfectly that it will require no further attention; but if a number of burners are used, it will certainly take him longer to regulate them, and will require almost constant attention, in order to keep the heat evenly distributed in the furnace, and the result is unsatisfactory in both the quantity and quality of the output. In an oil furnace equipped with a hydrocarbon burner which thoroughly atomizes the fuel, combustion is so perfect that a smokestack is not needed, and should never be used, for it allows a quantity of heat to pass away.

The superiority of oil over coal as fuel is as great as that of coal over wood, and each succeeding year will note great advancement in the use of liquid fuel, for a test always convinces the most skeptical of its real merit. The increasing demand for this fuel is a compliment to its value, and will stimulate the development of new oil fields until the supply equals the demand.

A New Book on Gas-Engines and Producer-Gas Plants.

A new book has just been issued entitled "Modern Gas-Engines and Producer-Gas Plants," by R. E. Mathot, which is so clearly written and which so admirably fills a niche that has hitherto remained empty in technical literature, that we may be pardoned for calling it to the attention of our readers. Without the help of mathematics the author has shown forcefully how a gas-engine ought to be built, installed, and maintained in good condition, how defects in its operation may be remedied, and how the user ought to proceed in buying an engine for his purpose. Many a useful suggestion as to the proper method of designing vital parts is thrown out. Most valuable is a thorough discussion of producer-gas—the fuel of the future. Indeed, no book in English presents anywhere near so exhaustive a treatment of this important subject. Excellent diagrams stud almost every page of the work. The publishers of this paper will furnish descriptive circular on request, or send the book postpaid on receipt of $2.50.

The degree of humidity of the atmosphere, says M. Jaubert, a Paris meteorologist, is shown by the state of the pavements. When these remain covered with mud there will be no immediate change in the weather.

HOW TO MAKE AN ELECTRIC SOLDERING IRON.

BY ARTHUR B. WEEKS.

A design for an electric soldering iron is given in the accompanying illustration. The drawing is made to scale and is suitable for a working drawing. The core, *C*, can be made of iron or copper. Cut a 7-16-inch standard thread on one end, leaving a shoulder so as to make a tight fit on washer, *A*. At the opposite end, the washer does not fit over the core, but a hole is drilled for a screw ¼-inch No. 20 round head, ⅝ inch long. The dark lines indicate the mica lining. After fitting the India mica on the core, put micanite rings over each end; these will assist in holding the mica in place. The best fit of mica can be made by using thin pieces and pasting them around until the desired thickness is attained. A suitable mica cement is commercially known as "Brown Dielac." The insulating washers at each end should be of the best micanite, commonly used for commutator segments, since it is free from mica cement and therefore very homogeneous.

The copper tip can be made from an ordinary soldering copper, cut off, drilled, and tapped. The outside shell can be made of steel tube with an end piece brazed on, and a tube, *D*, brazed thereto. Several holes should be drilled in this tube for free air circulation. Have an ordinary tool-handle of wood. The washer, *B*, serves also as a rest or guide for the outer shell, *E*. The only point at which the shell is secured in any way is at the copper end, where four or five small machine screws are used around its circumference.

Before putting on the shell, and after the copper is secured in place, all is in readiness for winding on the wire. This is the important part of the operation. German-silver wire has been used with more or less success, but it is rather short-lived. Krupp iron wire is extremely desirable, and answers the purpose well. The writer has tried several sizes of wire; for ordinary use No. 26 B. & S. will be found satisfactory. Put the copper in a lathe and pass one end of the bare wire through a mica-lined hole close to the core, as shown on lower side. Much depends on this insulation. Wind carefully, spacing the turns about the thickness of the wire, or a little more. When the first layer is wound, cover it over with mica, the same as was used on the core. Do not let the wire slacken at all. Wind the following layers in the same way, insulating carefully between each. If properly proportioned, there is space for four layers of wire. The copper should heat sufficiently to make solder flow well in about five minutes. Since the mica will not endure excessive heat for long, the wire must be well proportioned. This can easily be ascertained by trial. (When the tool is in use, favor it as much as possible by shutting off current.) When the fourth and last layer of wire is completed, bring the end out through a well-insulated hole at the top of washer, *B;* and where the winding is finished, pass a piece of bare wire over the last layer of mica, and twist it near the washer where the wire passes through, to keep the wire from slacking up. Tie again at center and at further end, to retain mica. Make connections for asbestos-wrapped wires in the handle as shown. Make a loop at each end, and pass a small stove bolt through them. Insulate the bolts with asbestos; allow a little slack in handle. Connect a lamp plug to the end of wires, *S*, allowing as much wire as desired. As constructed, there is no way to make the wires fast to binding posts; this has simplified the construction, and will be entirely satisfactory, provided the tool is not allowed to swing from the outside wire, *S*. To make this part still more complete, binding posts can be set in, however, in the outer end of the handle, and provided with suitable shell over them. Avoid using fluid flux too freely on the copper while at work, lest it find its way into the windings and cause a burn-out.

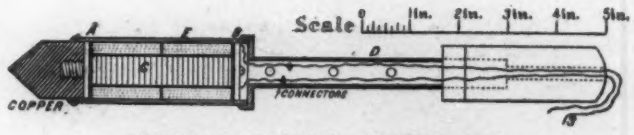
This soldering iron should take from one to two amperes on 110-volt circuit. It can be connected into any lamp socket and used with perfect safety in places where there is great fire risk. It is especially useful where torches and gasoline stoves and charcoal pots are prohibited. The copper tips are renewable. When the wire is rendered brittle from continued use and a break occurs, it is best to rewind rather than try to patch it up, since it would not last long, but would continue to open right along. The writer has used silicate of soda with considerable success for cementing the wires in place. This can be tried later; and where greater heat is required with special soldering devices, or where wire passing five to eight amperes is used and mica will not answer at all, some such medium must be used, unless the construction is such that porcelain can be utilized for insulation.

Where silicate of soda is used, the entire iron windings should be baked in an oven before applying current. The material will then be solid throughout.

There are few troubles incident to the use of an electric soldering iron. Usually if an iron fails to give out heat, it is due to an open circuit in the windings or at the connections or in the attachment plug. The attachment plug should be fused. See that it is always intact.

An open circuit may be due also to complete oxidation, as well as to fusing caused by a short circuit in the windings. Again, if the windings become grounded, that is, if they touch the shell in places that would short-circuit the coil, the fuse will blow until the fault is remedied. For this reason, the insulation must be careful and thorough throughout. Look well also to the insulation where the wires pass through the washer, and cover them thoroughly with asbestos from the point where they leave the washer, using the previously mentioned mica paste.

In damp places it is well to stand on a board while using the iron. In locations containing much iron construction, do not handle any part of such construction with one hand while using the iron with the other, as a ground on the system may occur, and should another take place on the opposite side while thus engaged, injury is liable to follow.



SECTION OF AN ELECTRIC SOLDERING IRON.

THE DOUBLE-DECK SUBWAY SYSTEM.

Broadway, with its enormous traffic, has been for many years a coveted route for underground railway builders. The physical obstacles which would be met with under the street surface are many. These obstacles, such as the cable road structure, the gas and water pipes, sewers and electric wire ducts, are so located that unless the tunnel is built at considerable depth they must necessarily be disturbed. During construction the street traffic must be maintained without serious interruption, as also must the use of the gas and water pipes, electric wires and sewers.

A somewhat intimate acquaintance with the above conditions under Broadway led Mr. J. W. Reno, of this city, to design a number of years ago a form of subway, and a method of construction, which would provide a complete four-track railroad with the greatest possible economy of space. This form of construction has become known as the Reno double-deck tunnel, which consists essentially of two side walls, a roof, and floor, divided vertically and horizontally by columns and girders into four compartments or trackways.

The routes which are now under consideration by the Rapid Transit Commission include Broadway and Lexington Avenue, the width of which between curb lines is approximately 40 feet. The fact that a tunnel with four tracks on a level requires a width of at least 53 feet makes it impossible to build such a structure without encroaching to a large extent upon the sidewalk vault property now in use by adjoining buildings. These sidewalk vaults are very valuable, and contain in many cases boilers, engines, and other conveniences which it is next to impossible to locate anywhere else. Experts have testified before the Rapid Transit Commission that it would cost the city $12,000,000 to condemn these vaults along Broadway for railroad purposes. It is obvious that the construction of the Reno plan would not necessitate the expenditure of any money for this purpose.

Another disadvantage in the construction of a wide tunnel is the fact that the operations of tunneling would be in close proximity to the foundations of the buildings, necessitating the shoring up and underpinning of many structures. This work alone has been estimated by engineering experts before the commission to amount to approximately $3,500,000 additional. In the Reno tunnel, which is clearly illustrated on the front page of this issue, the side walls are distant from the building line about 25 feet, combined with a new method of construction, makes it unnecessary to disturb foundations of any of the buildings, thus saving a very large sum on this head. The method of construction proposed is as follows:

A narrow trench would be constructed on one side of the street at a time, by driving down a special form of steel sheet piling, and excavating the ground between the sheeting. This trench would then be filled in with concrete, to form the side wall of the tunnel. The other wall of the tunnel would be constructed in a similar manner on the opposite side of the street, after which the steel beams, which form the roof of the tunnel, would be placed in a position under the cable road structure, the tunnel roof completed and the street surface restored. Simultaneous with the construction of the tunnel wall, the pipes, sewers and electric wire ducts would be surrounded by a permanent pipe gallery, so that there would never be any necessity in the future for tearing up the street surface in order to make alterations and repairs. It is well known that those doing business on Broadway are put to great loss, amounting to millions of dollars in the aggregate, on account of the almost endless disturbance of the street pavement necessitated by the present imperfect arrangement of the pipe and wire systems. In the plan here illustrated there would be ample space for commodious pipe galleries on either side of the tunnel structure.

For a considerable distance along the Broadway route the base of the double-deck tunnel would be below the water line, and the construction along this portion would be similar to that previously described, with this exception, that in order to preclude any possibility of the settlement or movement of the ground, it is proposed to freeze by well-known methods the wet sand under the line of the base of the tunnel, previous to its excavation. After the tunnel walls and invert are constructed, it will be perfectly safe to allow this frozen material to thaw, and return to its previous condition.

Some objection has been raised to the double-deck tunnel because of the possibility of noise and vibration from the trains on the upper tier of tracks; but in the opinion of the writer all vibration and noise will be done away with if the tracks are laid upon the ordinary stone ballast, and supported by sufficiently strong flooring, composed of steel and concrete construction. By reference to the engraving, it will be seen that the bases of the columns between the express tracks are inclosed by a concrete wall. The purpose of this is to distribute the pressure of the columns along the center line of the invert, and also to act as a safety device in case of the derailment of a train, to prevent its butting into a column and causing great damage to the structure. This wall is not made continuous, cross openings being thus left in order to permit of the ready passage of the workmen from one track to another. These openings also provide refuge places in which the workmen can stand out of the way of passing trains.

At the local stations in the double-deck subway, the pipe and wire ducts would be carried over and under the platforms, the waiting rooms being located under the cross streets similarly to the present subway. The express stations will be located at long intervals, and at such places as City Hall Park, Union Square, Madison Square, 42d Street, 72d Street, 96th Street, etc., where it would be perfectly practicable to spread the local tracks and bring the express tracks up a grade of 7½ feet, the local tracks being carried down a grade of 7½ feet to meet them. This construction would result, at the express stations, in placing all four tracks on a level, with island platforms between them, giving the same facilities for transfer of passengers from the local to the express trains as is now the case in the corresponding stations of the present subway.

Railroad engineers will appreciate the advantage of this arrangement, in that it will give to the long, heavy express trains an ascending grade as they approach the station, and a descending grade to assist in their acceleration as they leave the station.

In conclusion, from the foregoing it can be conservatively stated that this double-deck tunnel will have all the advantages in convenience and economy of operation possessed by the four-track level tunnel, while at the same time it will be free from the disadvantages of encroachment upon private property, interference with building foundations, and interruption of street traffic; and finally, because of the inherent economy of its method of construction, it will save millions of dollars to the taxpayers.

Meteorological Summary, New York, N. Y., March, 1905.

Atmospheric pressure: Highest, 30.61; lowest, 29.71; mean, 30.12. Temperature: Highest, 74; lowest, 14; mean, 40; normal, 38. Warmest mean, 48, 1903. Coldest mean, 29, 1872. Wind: Prevailing direction, northwest; maximum velocity, 47 miles. Precipitation, 3.65. Average, 4.05. Deficiency, 0.40. Greatest, 7.90, 1876; least, 1.19, 1885. Total snowfall, 3 inches. The maximum, 74, on the 29th, is the highest temperature for March recorded by the Weather Bureau since its establishment in 1871.

A petition in bankruptcy was filed recently in the courts at New York by Annie L. Costen, the daughter of the inventor of the Costen lights, which are used generally as signals on shipboard. The construction and composition of these lights is a secret closely guarded by the family. After the death of the father, the business was carried on by the widow, and upon the latter's demise the daughter succeeded to it, and conducted it in a cottage on Staten Island, where she also lived. The death of the father resulted from an accident while making the lights, and recently the daughter had a narrow escape from the same fate by a mishap which caused the partial destruction of the Staten Island cottage, and it was this incident which caused the woman's financial distress.

"Sunbeam." W. L. length 154.7 feet. Date 1874.

"Ailsa." W. L. length 89 feet. Date 1895.

"Thistle." W. L. length 110 feet. Date 1901.

"Fleur-de-Lys." W. L. length 86.5 feet. Date 1890.

"Valhalla." W. L. length 140 feet. Date 1892.

"Apache." W. L. length 178 feet. Date 1890.

"Utowana." W. L. length 155 feet. Date 1891.

"Atlantic." W. L. length 135 feet. Date 1903.

"Hildegarde." W. L. length 103.4 feet. Date 1897.

"Endymion." W. L. length 101 feet. Date 1899.

"Hamburg." W. L. length 116 feet. Date 1893.

THE FLEET OF YACHTS ENTERED FOR THE EMPEROR'S OCEAN CUP RACE FROM SANDY HOOK TO THE LIZARD.

THE ENTRIES FOR THE GERMAN EMPEROR'S OCEAN CUP RACE.

We present a spirited picture, showing all of the ocean yachts that are entered for the great race from Sandy Hook to the Lizard, which gives one a realistic impression of the magnitude of this great sporting event. It is not an infrequent occurrence for a dozen or more yachts of moderate size to be entered in a single contest during a yachting season here or abroad; but rarely, indeed we may safely say never, have nigh upon a dozen of the biggest sailing yachts in the world gathered for an ocean race, or indeed for a race of any kind. Indeed, for a parallel, we should probably have to go back to the ever-famous contest when the "America" captured her historic cup; and the biggest yachts in that race were of modest proportions compared with such vessels as the "Valhalla," the "Apache," or the "Utowana." In the annual cruise of the New York Yacht Club, the port-to-port races have served to send a large number of the big fellows across the line; but never such a crowd as that which is shown on the accompanying page.

On looking at the table of dimensions, etc., and at the picture itself, one is struck with the great variety in size, rig, and model presented by this fleet. In rig, the vessels run all the way from the yawl "Ailsa," formerly a racing cutter, up to the great full-rigged ship "Valhalla." The fleet includes two-masted and three-masted schooners, the topsail schooner rig, and the bark rig. The models range from the low-freeboard, deep-ballasted "Ailsa," with her comparatively flat floor, deep fin keel, cutaway forefoot, and raking stern post, to the high-freeboard, heavily bulwarked, long, straight-keeled vessel of the "Utowana," "Hamburg," "Sunbeam," and "Valhalla" type.

The most imposing vessel of the fleet is, of course, the huge "Valhalla," a full-rigged auxiliary ship of 1,490 tons Thames measurement, now owned by the Earl of Crawford. Although she is a ship in size, "Valhalla" has fairly easy lines, and she carries a big sail spread. With her crew of one hundred men, and an experience gained on long-distance cruising in all parts of the world, she should be sailed for everything that is in her; and if the winds are fair, and strong from start to finish, especially should it be necessary to tie down reefs, the big ship may be regarded as a not-unlikely winner.

The next largest vessel, the "Apache," like the "Valhalla," was built in England; but she is now enrolled in the New York Yacht Club and owned by Edmund Randolph. She is 178 feet on the waterline, 28 feet broad, and draws 16.6 feet of water. These dimensions may be compared with those of the "Valhalla," which is 240 feet long on the waterline, 37.2 feet in breadth, and 20 feet in draft. Then follows the American-built "Utowana," 155 by 27.8 feet by 14.6 feet, an auxiliary fore-and-aft schooner, owned by Allison V. Armour. Next in size is the old English-built "Sunbeam," a square-rigged schooner, auxiliary, measuring 154.7 feet by 27.6 feet and drawing 13.9 feet, built in 1874 for Lord Brassey, her present owner. The next largest vessel is the fast and handsome three-masted auxiliary, fore-and-aft schooner "Atlantic," the most modern vessel in the fleet, built in 1903 for her present owner, Wilson Marshall. Her dimensions are 135 feet waterline by 29 feet beam by 16½ feet draft.

Then comes the only German-owned vessel in the fleet, the "Hamburg," a fore-and-aft schooner built in England and formerly known as the "Rainbow." She measures 116 feet by 23.9 feet by 15 feet draft. The schooner "Thistle," built in this country in 1901 and owned by Robert E. Tod, is 110 feet on the waterline, by 27.8 feet beam by 14 feet draft. The "Hildegarde," an American-built fore-and-aft schooner, owned by Edward R. Coleman, built in 1897, is 103.4 feet on the waterline, by 26 feet beam, and draws 16.9 feet. Next in point of size is the "Endymion," a celebrated deep-sea fore-and-aft auxiliary schooner, which is famous as having made the quickest passage on record over the transatlantic course, sailing from Sandy Hook to the Needles in the fast time of 13 days, 20 hours, and 36 minutes. Judged on this performance she must be regarded as one of the strongest competitors for the cup. Her dimensions are 101 feet by 24.4 feet by 14 feet.

The "Ailsa," now owned by Henry S. Redmond, is 89 feet on the waterline, 25.5 feet in beam, and draws 16.6 feet of water. Built to defeat the "Britannia" she made a good showing against that vessel, winning about as many races as she lost. In her contests with the yawl "Vigilant" in this country, she was more often beaten than not, although she made a brilliant win of the Astor cup for single-masted vessels and yawls in the season of 1902. The smallest vessel entered for the race is the schooner "Fleur-de-Lys," owned by Lewis A. Stimson and built in 1890. Her waterline length is 86.5 feet; her beam 21.9 feet, and her draft 13 feet.

The race will be sailed without any handicap, and the distance will be from 2,900 to 3,000 miles. The auxiliaries must unship their propellers, and only hand power may be used in working the sails.

THE LARGEST DIAMONDS IN THE WORLD—ACTUAL SIZE.

1. Koh-i-noor after the second cutting, 106⅛ carats. 2. Loterie d'Angleterre, 49 carats. 3. Great Mogul of Russia, 279⅛ carats. 4. Orloff, 194¾ carats. 5. Koh-i-noor after first cutting, 279 carats. 6. Regent, 136¾ carats. 7. Grand Duc de Toscane, 139.16 carats. 8. Etoile du Sud, 124 carats. 9. Etoile Polaire, 40 carats. 10. Tiffany yellow diamond, 125 carats. 11. Blue diamond d'Angleterre, 44¼ carats. 12. Sancy, 53½ carats. 13. Imperatrice Eugenie, 51 carats. 14. Shah, Russia, 86 carats. 15. Nassak, 78⅝ carats. 16. Pacha d'Egypt, 40 carats. 17. The famous Great Premier Diamond recently discovered, 3032 carats. 18. Tiffany diamond, 969 carats.

THE INTERNATIONAL OCEAN RACE FOR THE KAISER'S CUP.

Yacht.	Rig.	Where built.	Yacht Club.	Length in feet.	Beam in feet.	Draft in feet.	Owner.
Sunbeam.	Auxiliary Schooner.	England.	Royal Yacht Squadron.	154.7	27.6	13.9	Lord Brassey.
Ailsa.	Yawl.	England.	New York Yacht Club.	89.0	25.5	16.6	Henry S. Redmond.
Thistle.	Schooner.	America.	Atlantic Yacht Club.	110.0	27.8	14.0	Robert E. Tod.
Fleur-de-Lys.	Schooner.	America.	New York Yacht Club.	86.5	21.9	13.0	Lewis A. Stimson.
Valhalla.	Auxiliary Ship.	England.	Royal Yacht Squadron.	240.0	37.2	20.0	Earl of Crawford.
Apache.	Auxiliary Bark.	England.	New York Yacht Club.	178.0	28.0	16.6	Edmund Randolph.
Utowana.	Auxiliary Schooner.	America.	New York Yacht Club.	155.0	27.8	14.6	Allison V. Armour.
Atlantic.	Auxiliary Schooner.	America.	New York Yacht Club.	135.0	29.0	16.5	Wilson Marshall.
Hildegarde.	Schooner.	America.	New York Yacht Club.	103.4	26.0	16.9	Edward R.Coleman.
Endymion.	Auxiliary Schooner.	America.	New York Yacht Club.	101.0	24.4	14.0	George Lauder.
Hamburg.	Schooner.	England.	Kaiserlicher Yacht Club.	116.0	23.9	15.0	German Syndicate.

THE GREAT PREMIER DIAMOND.

Quite a stir was made a couple of months ago by the announcement that a huge diamond, three times as large as any before discovered, had been unearthed in the Premier Mine, near Pretoria, South Africa. This precious pebble has since been brought to London, carrying, on the way, an insurance of $1,250,000. The first report that the stone was as large as a tumbler, and was worth three or four million dollars, has proved to be no exaggeration. The mammoth gem

measures approximately 4 x 2½ x 1¼ inches, and weighs 3,032 carats, or 1.7 pounds troy, equivalent to about one pound and six ounces avoirdupois. The stone is almost perfectly pure; a few grains are present, and it contains some flaws or cleavage planes, but fortunately they are so disposed that they can be cut away without appreciably reducing the size of the cut gem. Dr. G. A. F. Molengraaff describes the diamond as a single crystal having no twinning planes or lamellæ. It is perfectly transparent, and looks like a piece of pure ice. He says "it is certainly the purest of all the very big stones known." Its structure shows that the stone was originally much larger. This is proved by the four flat cleavage planes, which have the regular octahedral position. Only a small portion of the natural surface of the stone remains, and the fragments broken off must each have been very large. Whether these fragments will ever be found is a question which introduces the interesting study of the formation of diamonds.

It has long been known that diamonds are crystals of pure carbon, and it is supposed that the crystallization took place under a tremendous pressure and heat. The South African mines particularly bear out this theory. The deposits appear to occupy the chimneys of extinct volcanoes. They form cores of circular or oval cross section, bounded by walls of carboniferous shale. This core, near the surface, where it is subjected to the influence of the weather, is of a yellowish color, but lower down is composed of a bluish rock of igneous character, called by the miners "blue ground." In this the precious crystals are embedded. Their broken condition, and the fact that they are found in rock formation of many different compositions, indicate that the blue ground was not their original matrix, but that the diamonds were cast up by volcanic eruptions from great depths, where the tremendous pressure and intense heat were sufficient to crystallize the carbon. In the case of the Premier diamond, the force of the eruption must have been so great as to cleave the fragments from the stone during its passage up the vent or pipe of the volcano. These fragments may have been blown out at the time of the explosion, or may be still awaiting discovery somewhere in the volcano chimney.

At any rate, the portion found is large enough to satisfy the owners; indeed, it is so large as to prove somewhat of a burden. It seems hardly possible that it will be bought by any private collector. Apparently its only office would be to grace a royal collection, but even a rich government would hesitate to pay the sum a diamond of this size should bring. The value of the stone is, of course, a matter of conjecture. Between the years 1750 and 1870 diamonds were rated according to the square of their weight multiplied by the value of a single carat. Thus, if one carat sold for $100, two carats would sell for $400, three carats for $900, and so on. On the same basis, the value of the great Premier diamond would be 3,032 times 3,032 times 100; or $919,302,400. Of course, no such sum will ever be paid for the stone. In fact, it was because of the large stones discovered in Africa that this system of rating diamonds was abandoned. It is considered possible that the Premier diamond may be sold for from $2,500,000 to $5,000,000; but even these figures may be entirely too high, and the actual value is entirely dependent on the bids received. Possibly the stone may suffer the fate of the large Syndicate or Tiffany diamond dug up in the De Beers mine a few years ago. This stone weighed 969 carats in its rough state; but instead of cutting it as a single large brilliant, it was made more salable by cleaving it into ten smaller stones. However, it seems like a desecration to break so large and perfect a stone as the great Premier diamond, though, as we have just stated, large stones are apt to prove a great burden, and have the reputation, well borne out by past history, of bringing bad luck to their owners. Except for the really modern stones, all of the large stones of the world have histories which are black with crime.

For purposes of comparison, we have shown in the accompanying engraving life-size illustrations of the most famous large stones, glass models of which were kindly placed at our disposal by Dr. George F. Kunz, the famous gem expert. The Syndicate or Tiffany diamond, which previously held the record as the largest stone, is shown in Fig. 18, and the great Premier stone is illustrated in Fig. 17. The huge proportions of the latter, as compared with the rest of the collection, will be readily apparent. Of course, the stone will lose much of its size when cut; but owing to its present good form, and the great skill possessed by the modern lapidary, it is probable that the finished gem, if the stone be cut as a single brilliant, would weigh many times as much as any other cut stone now in existence. The famous Koh-i-noor, which is shown in Figs. 1 and 5, is a remarkable example of the loss by cutting which a stone is apt to sustain. Originally, it is said to have weighed 793⅝ carats. An unskilled Venetian lapidary cut it to the shape shown in Fig. 5, reducing it to a weight of 279 carats. Later it was cut to the more symmetrical shape shown in Fig. 1, which still further reduced its weight to 106 1-16 carats. Many remarkable stories are told of this stone. According to one account, it was worn five thousand years ago by Karna, one of the heroes celebrated in Indian legend. By some it is considered a part, with the famous Orloff stone, Fig. 4, of the Great Mogul. This, however, is now pretty generally discredited. The Orloff stone derives its name from Prince Orloff, who presented the gem to Catherine II. of Russia. It is now mounted in the tip of the Russian scepter. The diamond has a "rose" shape, that is, it is cut with a flat base, whereas the usual cutting is called the brilliant. The Shah, Fig. 14, represents a third type of cutting, called the "table cut."

The Regent or Pitt stone, No. 6, is very beautiful. It weighs 136¾ carats, is pure white, and of almost perfect shape. Before the South African mines were opened, it was considered the finest stone in existence. The Florentine, or Grand Duke of Tuscany, belonging to the Austrian crown collection, is a yellow stone weighing a little over 133 carats. Fig. 8 shows the Star of the South, a remarkably fine stone, picked up along the river Bogageno, Brazil, by a negress in 1853. It is the largest diamond ever discovered in South America, weighing 254½ carats in the rough. Its weight, cut, is 124 carats. The Portuguese crown jewel, Brazil, weighing 900 carats uncut, and once valued at $2,000,000, is now known to be a white topaz and not a genuine diamond. The Tiffany diamond, shown in Fig. 10, remarkable for its yellow color, has a weight of 125 carats; and the Hope diamond, Fig. 11, has a rare blue color, which gives it a value of $250,000, even though its weight is but 44¼ carats.

The Sancy, 53½ carats, shown in Fig. 12, has a remarkable history, which has been traced back to 1477, when it was lost at the battle of Nancy by Charles the Bold. Then it came finally through private hands to Sancy, a Huguenot nobleman. While Sancy was an ambassador in Solothurn, the diamond was sent to Henry III. as a pledge. The bearer of the gem was attacked on the way and killed; but he swallowed the gem instead of giving it up to his assailants, so that Sancy recovered the stone by opening the body of his faithful servant and taking the precious gem from his stomach. In 1688 it came into the possession of James II., and later was worn by Louis XV. at his coronation. In 1835 the Russian Emperor bought it for half a million rubles. In 1889 it was again in the market, and was finally sold to a collector for $70,000.

It is to be hoped that the mammoth Premier diamond will not enter upon so troublous a career as its famous predecessors.

The Current Supplement.

In the history of all improvements in the arts and sciences, we would have to search long to find a case where such an important forward step was taken as the sweeping change from steam to electric traction which is taking place on the New York Central Railroad over its terminal lines in New York city. The technical importance of that change is fittingly described and illustrated in the article entitled "The Parting of the Ways—From Steam to Electricity," which opens the current SUPPLEMENT, No. 1527. Of technological interest may also be mentioned contributions on "The Manufacture of Inlaid Linoleum," "Celluloid of Reduced Inflammability," the "Fur Supplies and Markets," "Dyeing of Furs," and "Kryptol, a New Substance for Electric Heating." A model steam engine is so thoroughly described and illustrated that any one can make it. Students of electricity will read with interest the articles on electricity at high pressures, the construction of a four-inch spark induction coil, and Mr. Marconi's observations on recent advances in wireless telegraphy. Until within the last few years there has been a very general opinion that the moon is a cold, dead world, or, as it has been sometimes expressed, a burned-out cinder upon which nothing ever happens. Prof. Pickering in a most instructive article disproves that supposition, and describes some changes upon the moon's surface which he has himself observed. Miss Elizabeth A. Reed writes on the "Precious Stone Industry of the United States." Prof. A. Lecroix's new book on Mont Pelé is reviewed. A pleasantly-worded article by G. G. Chatterton describes some idle hours in Cæsar's city. "How Miniature Cameras are Constructed and Used" is very fully explained by Edward F. Chandler. Cocoons that yield colored silk are described. Dr. Witt continues his instructive review of the chemistry of patinas. Commonplace things often become the most interesting when we attempt to investigate their causes. How true this is will be found in an article on rain, one of the most valuable in the SUPPLEMENT.

The term "geology" was first used in the modern geological sense by De Saussure in 1779 in writing on the Alps. De Luc one year earlier had suggested the term geology in a preface; but he actually used the term cosmology. This is stated on the authority of Geikie and Emmons.

Correspondence.

How to Keep Cake Fresh.

To the Editor of the SCIENTIFIC AMERICAN:

I have found that fresh bread in slices about one inch thick (renewed when it gets dry) of bulk about half the cake to be kept "fresh," put in the tin with the cake causes the cake to remain "fresh."

CORTLANDT DE P. FIELD.

New York, March 27, 1905.

Early Breech-loaders.

To the Editor of the SCIENTIFIC AMERICAN:

In the article on "Multi-Repeating Arms" in your issue of the 25th instant, you state that the rifle patented by Hall in 1811 "may be considered as the first successful military breech-loader." It is matter of history that in the time of the American revolutionary war, a corps of sharpshooters in the British service was armed with breech-loading rifles, invented by their commander, Col. Patrick Ferguson, who was afterward killed at King's Mountain. A description of the arm is given in Greener's "Gun and Its Development." G. A. F.

Montreal, March 29, 1905.

Side Swimming of Fishes.

To the Editor of the SCIENTIFIC AMERICAN:

As is well known, the halibut, flounder, and I believe the skate, and perhaps other fishes swim on their side, and the thought occurred to me whether the same side was always uppermost, and some two years ago I began watching several small markets to try to learn if the rule was universal, and found all to be with the left side up until to-day, when I was rewarded by discovering a fine halibut with the right side up.

I understand it is the theory of naturalists that these fish once swam upright as do other fish, and for some reason nature saw fit to turn them over on one side, in which they have remained permanent to the present time. There must have been some object in view in turning them over, as well as a preference to the left side; if so, why was this one I mention turned the reverse from the general rule? As I take it, its progenitors must have been so turned from the very beginning, which may have been thousands of years ago, and probably was a very gradual process, as one eye was brought around, but no attempt was made to change the mouth or gills, which remain in their natural position. I do not understand how a single individual could have otherwise been so reversed. It is not a case of the "white blackbird" or other albinos.

I would be pleased to hear from naturalists through the columns of your valuable paper on the subject.

Chicago, March 16, 1905. J. E. GARSIDE.

The Death of Alexander Lagerman.

In Jönköping, Sweden, an eminent Swedish inventor and engineer recently died. To him Sweden owes the development of its great match industry. He invented a series of machines which produced the match from the raw log with such rapidity that it enabled that country to compete with other match-producing countries.

His patent rights were sold a few years ago to the American match trust.

Other problems likewise arrested his attention for the greater part of his life, namely, the invention of a typesetting machine for book and newspaper printing, the patent for which he succeeded in selling to England some time ago for $126,000.

Lagerman was born in Sweden in 1838.

The Development of Motor Traffic.

Some interesting remarks were made by Mr. C. S. Rolls in the course of a paper on "The Development of Motor Traffic." After describing older types of vehicles, Mr. Rolls said that it was not until 1894 that the development became rapid. In the Paris-Bordeaux race in 1895, a speed of 15 miles an hour was attained, while in the Paris-Madrid race of last year the rate was nearly 70, and now a maximum speed of 100 miles had been reached. After the passage of the Light Locomotive Act, 1896, the manufacture of motor cars in Great Britain had shown remarkable growth. There are now at least 130 makers, but the trade did not yet equal that of France, where the industry employed 200,000 men, and last year's exports amounted to about $5,000,000. England, however, produced more cars for heavy traffic. Last year 6,133 light vehicles were imported, as against 3,747 in 1904, and the value of cars and parts imported during the year amounted to nearly $10,000,000. He anticipated that the time was approaching when a trustworthy car to carry three persons at a rate of 20 to 25 miles an hour could be purchased at from $500 to $750.

A new use for aluminium is found in making spools and bobbins, particularly for mill work. The aluminium bobbins weigh less than half as much as wooden ones, are less influenced by changes in heat and moisture, and are said to be more durable.

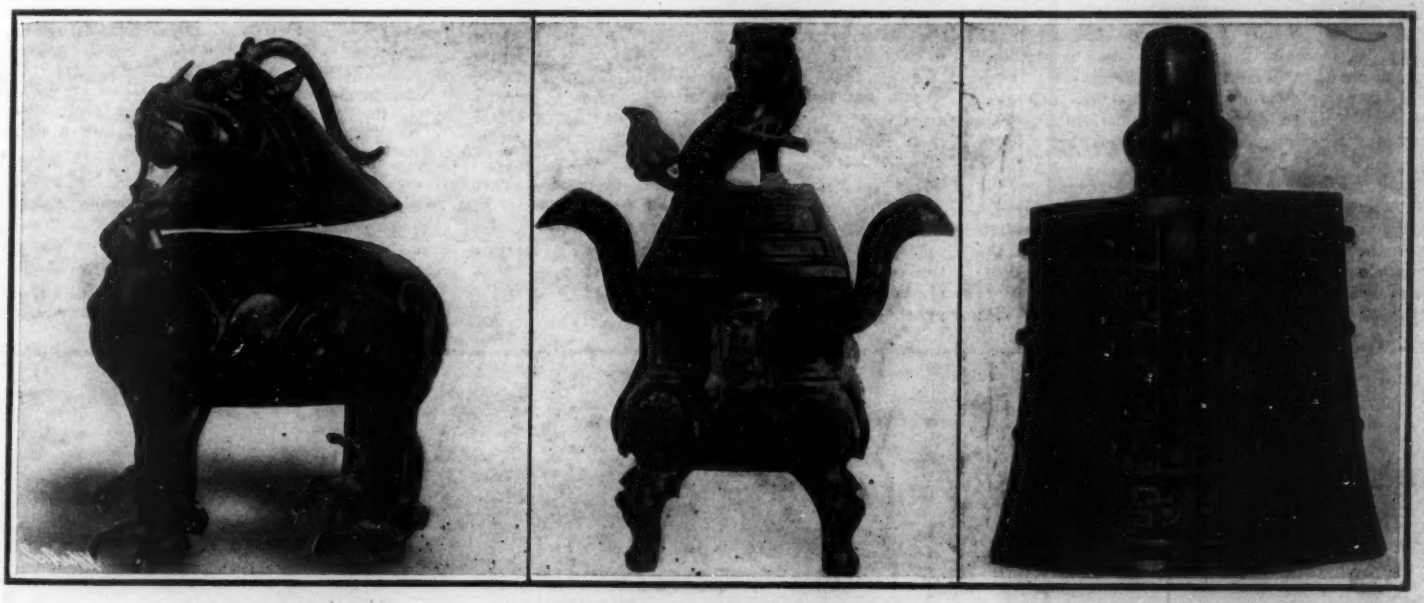
SOME REMARKABLE OLD CHINESE BRONZES.

BY WALTER L. BRADLEY.

The American Museum of Natural History has installed the largest and most comprehensive Chinese collection that has yet been brought from the Celestial empire. This exhibition is due to the generosity of Jacob S. Schiff, Esq. Dr. Berthold Laufer, the well-known Oriental traveler, for the past two years has been carrying on systematic and painstaking researches in the various Chinese provinces to collect the material. Thoroughly familiar with the Chinese language, literature, and art, as he was, this trained explorer has been able to bring together an authentic and representative array of objects designed to show the past and present state of Chinese culture, and also the influence which Chinese civilization has had over the whole of Eastern Asia. The wonderful artistic development of the people is especially brought out in their unexcelled color work in porcelain, *cloisonné*, as well as their great skill in fashioning objects in metal, clay, and wood. One of the most valuable and interesting features of the collection is a remarkable series of bronze vessels, some dating before the Christian era. These form in themselves a noteworthy contribution to our knowledge of ancient Chinese art. Their shape, decoration, and technique are of no common order, and they unquestionably rank as the most characteristic products of the early bronze founders of China which have yet reached this country. The bronze vessels were used almost entirely in the elaborate ceremonial worship of Buddhism in the various temples and monasteries. A few were used as decorative features for temple and palace approaches. Incense vessels were largely employed; in most cases the incense issued from perforations in the cover or through the nostrils of the figure adorning the top. The Chinese bronze founder's chief aim was to make power attractive by combining it with the terrible. Ferocious mythological beasts, with glaring eyes and gaping mouths, surmount the top in many instances. In the ritual of this early period, each kind of vessel was devoted to a particular use. Those in the form of monsters and birds were incense burners proper. Prof. Frederich Hirth, occupying the chair of Chinese at Columbia University, in a recent interview has favored the writer with notes and opinions on some of the specimens, which lend additional interest to the accompanying narrative. The coming of the new religion of Buddhism from Hindostan in the first century A. D. marked an exceedingly important epoch in Oriental history and art. The early Buddhist missionaries not only proclaimed new doctrines and a new code of ethics, but were also the possessors of a new art and a new culture. The bronze vessels vary in height from less than one foot to two and a half, and differ accordingly in circumference. They show a love of round and square patterns, combined with a grotesque ferocity. The pair of joined horses are probably the oldest specimens in the collection, so ancient that there is no authentic record assigned to them, and none could be obtained by the explorer. Their origin is therefore shrouded in obscurity. From the fact that they are not so well executed, they are thought to have not been the work of a Chinese artist proper. Bronze models of horses were cast nearly two thousand years ago by workmen having carefully measured the build of the animal.

Vase of the Sung Dynasty Over 1,000 Years Old.

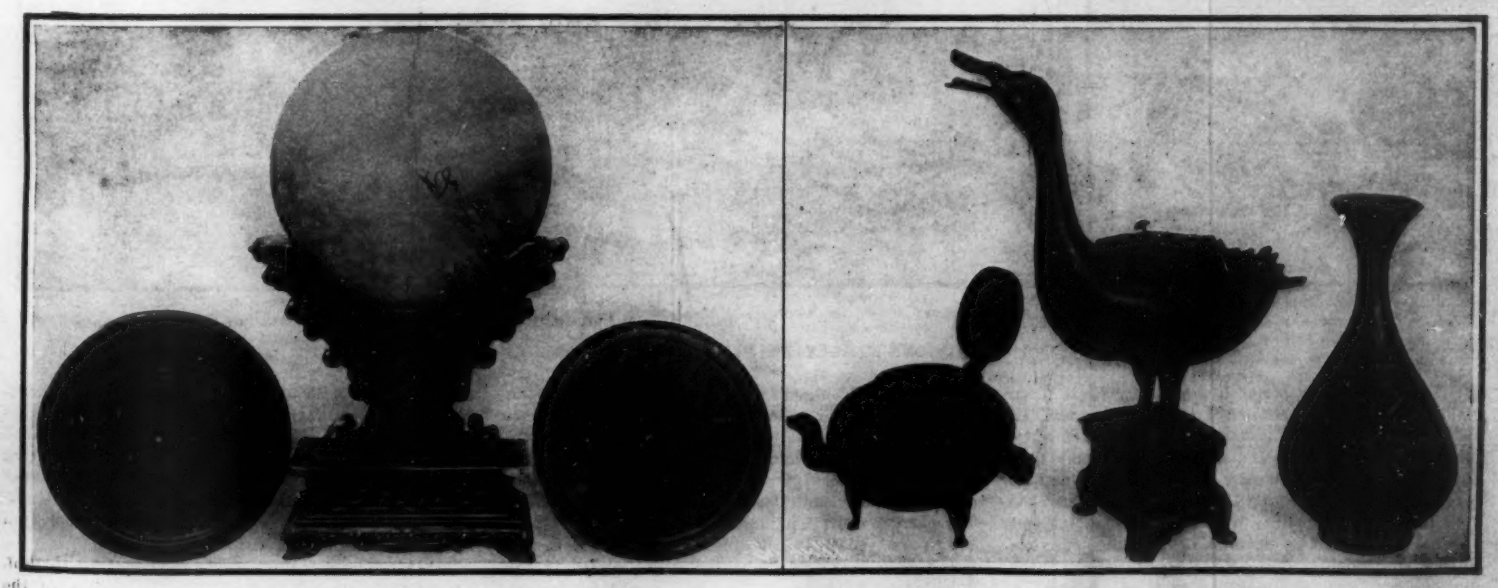
The bronze horses here figured were probably made in a remote locality where there was little artistic taste, or may have drifted from some savage or barbarous tribe outside the Chinese dominion, say the Tartars in the North or Siberia. Next to the horses in age is the bronze libation cup. It is authentically assigned to the Shang dynasty, 1766 to 1122 B. C. The tripod was a libation vessel used in the temples, known as Tsio, originally meaning a small bird, but written with a character of the same sound, denotes the ranks of nobility of the Chinese. The vessel has thus become, by way of a *jeu de mot*, a synonym of high rank, and is depicted with other good things and symbolic drawings of a congratulatory character. The bronze rattle or hand-bell, having a loose ball inside, which dates from the Han dynasty, 221-206 B. C., was commonly stuck on a bamboo stick, and used during the performance of the ancient pantomime to create a musical noise to enliven the dance. It was a popular instrument during the Han dynasty. The one here shown is about two thousand years old. It is a strange and notable



A Censer of the Ming Dynasty.

Temple Censer of the Ming Dynasty.

Temple Bell Inlaid with Gold and Silver.



Metallic Mirrors 1,500 Years Old.

Libation Vessels and Duck Incense Burner.

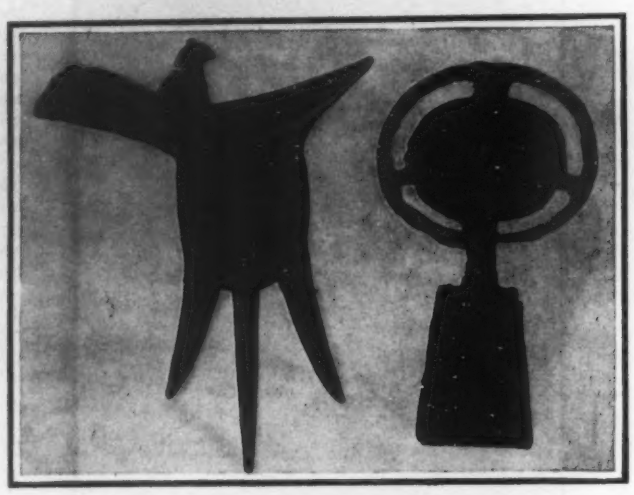
SOME REMARKABLE OLD CHINESE BRONZES.

fact that implements of a similar kind have been found among the old Scythian antiquities. The age of the bronze bottle of the Han dynasty may also be about two thousand years. The shape is met with in a number of porcelain vessels of all descriptions, and has formed the model which has been imitated in various materials by potters and workers in glass. It was well known under the Chou dynasty, and is described as Su-p'ing, that is, the plain bottle, in the catalogue of ancient bronze works. A rare type of a square bronze censer of the Ming dynasty, 1368-1644 A. D., with S-shaped handles on each side, has a cover representing a flattened pyramid crowned with a fierce mythological dog, the heavenly dog of Buddha, with a bushy tail and almost human expression of face. The thunder pattern of ancient times has been largely drawn upon for the filling out of spaces. The top fields of the cover show the mystic diagram known as Pa-kua, said to have been invented by the mythical Emperor Fu-hi. The characters for longevity and good luck are seen on the main side of the vessel. The bronze duck, standing on a footstool of the same material, is of the Ming dynasty. It is hollow, and its wings can be removed when incense sticks are placed inside, the pleasant and sacred fumes being emitted from the beak. Similar works were made under the Chou dynasty, 1122-255 B. C.; they were not, however, used for incense vessels, but for wine libations in the sacrificial service. In devoting vessels to purposes of incense, ancient forms, which can outdate the introduction of Buddhism, were often retained. The vessel looking like a teapot may be said to belong to this category, made in imitation of an ancient wine-holder for sacrificial purposes. The vase with rings attached is described as one of the strange creations of the Sung dynasty. Its whole surface is ornamented with 128 rings, and would remind one of the libation vessels known as Tsun of the Chou dynasty, which has furnished the prototype of a number of the later porcelain shapes. It was used as a sacrificial vessel in the temples. A censer of the Ming dynasty has a unique cover, on which a number of rats are amusing themselves among clusters of grapes and leaves. The feet of the vessel are formed of solid vine trunks. The ornamental scheme is quite ingenious, and has a touch of Japanese humor.

Equaling, if not surpassing, the ceremonial vessels in interest and historic significance, are the splendid series of metallic mirrors, forming the largest collection in the world. The main decorative feature of the mirrors is upon the back. Here, together with ornamental designs, are inscribed the prayers and mottoes of the owner and symbolic representations of that particular dynasty or period in which they were used. Magical powers were attributed to these mirrors. In size they ranged from that of a big coin to a large dish. It should be understood that the smooth side of these in most cases is now covered by rust, and no longer capable of reflecting the human face, but at the time they were made they were actually used for this purpose. The ancient method of grinding was lost during the middle ages. Small ones show convex surfaces, while those of larger size show concave. A noteworthy revelation in the history of Chinese art has been discovered and worked out by Prof. Hirth, whose researches prove that the ornamental parts of certain classes of these mirrors, notably those from the Han dynasty, were greatly influenced by Greek patterns. Other works may have been influenced in a similar way, but there are none in which the Hellenic art is brought out in such a striking way. The new collection contains large numbers of the variety called grape mirrors, the chief ornaments being formed of grapes, vines, and leaves. These grape mirrors were among the most valued relics of ancient art of the imperial museums of the middle ages, and are placed by Chinese archeologists in the time of the Han dynasty (206 B. C. to 291 A. D.). None are provided with an inscription which might throw light upon their exact date of manufacture. Certain analogies with objects of the same alloy, similar in size and general arrangement, though differently ornamented, but bearing distinct dates, seem to confirm the opinion of old Chinese writers that they were the work of the imperial bronze factory known as Shang-fang of the Emperor Wu-Ti, who died 86 B. C. Some of the other kinds of mirrors are dated and throw clear light upon the period of their production, but even if they had been manufactured centuries after the reign of Wu-Ti, the time which has elapsed since the introduction of the grape into China—about the end of the second century B. C. —would have been much too short for Chinese artists to develop an ornament of such high finish, showing the coils, leaves, and fruit of the vine in its most elegant conventionalism, a pattern which it took the artists of Greece many centuries to bring into full development. The fact is that the grape, together with a number of other elements of culture, was unknown in China prior to the expedition of the Chinese General Chang K'ien, whom the Emperor Wu-Ti sent on a political mission to the Indo-Scythians, who had established their capital somewhere on the Oxus River. The current court language, to judge from the Greek inscriptions on their coins, was probably Greek, and that tongue was spoken by the ruling castes in the neighboring kingdom of Bactria. It will be remembered that after the death of Alexander the Great, some of his generals founded dynasties in his former possessions of Asia. The easternmost of these Greek kingdoms was that of Bactria, the last Greek king of which died about 50 B. C., after which Bactria was swallowed up by Indo-Scythian conquerors.

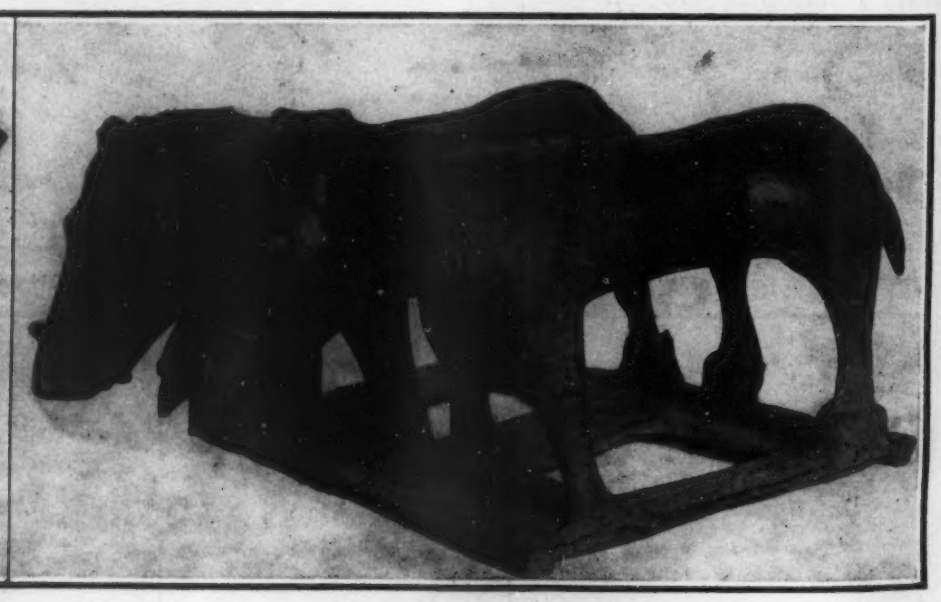
The star and unrivaled specimen of the collection, however, is a magnificent temple bell, of extraordinary interest, both from its age, odd shape, and rich decorations, gold and silver being lavished on parts of its surface. The principal ornament is a conventionalized dragon, with eyes inlaid with gold and the lines forming the body of silver wire. The characters forming the inscription on both sides are also of silver wire. A vast amount of historic and sacred lore clusters around this bell. Bells of this pattern are the oldest of all the inventions of the Chinese. They were known long before historical recollection. The Emperor Huang-Ti in the twenty-second century B. C. and others still earlier are said to have cast bells. This means that bells were among the very earliest elements of Chinese culture, and are probably as old as the early sacrificial vessels among the ancient bronze works. The art of casting bells was in full sway in China during the first millennium B. C. One of the main differences of the Chinese from those of European manufacture is the absence of a clapper. Large bells are not swung, but securely sustained by ropes and chains fastened to the handle in frames constructed of strong beams. The bell was struck by a wooden log suspended from above by two ropes and allowing the log to swing against a certain part, the striking of which would bring out the sound to the best advantage. One of its odd and peculiar ornaments is a number of thumblike projections, from the size of a button to that of a finger, arranged in three rows of three or four sizes, in all twenty-six projections. All the ancient bells of this kind show these buttons, which are thought to have been used for the purpose of adjusting the sound of the bell, since the bell was one of the chief musical instruments used in tuning the temple orchestra. The original pattern of this old bell is found in the Chou dynasty, 1122-255 B. C. The inscription is in silver wire, and as interpreted by Dr. Hirth reads: "Sung-kung Sü chi höng-chung," the translation of which is: "Höng, bell of Sü, Duke of Sung." The bell was called Höng as being classed with a musical instrument, so called, the invention of which was ascribed to one of the fabulous emperors of the third millennium B. C. According to the inscription, Sü was the personal name of the Duke of Sung, who caused the bell to be cast. Bells bearing this inscription were cast under the auspices of a Duke of Sung in the present province of Hunan, whose reign extended from 574 to 530 B. C. Dr. Hirth, however, is somewhat conservative in his opinion in regard to this specimen, on account of the ornamental shape of the Chinese character for shöu, "longevity," appearing right below the inscription, which he says he has never seen in works of the Chou dynasty, and the mixing up of which with Chou ornaments is looked upon by him as an anachronism in style.

The writer acknowledges his indebtedness to Prof. Frederich Hirth for certain notes embodied in the above narrative.



Libation Vessel and Hand Bell 2,000 Years Old.

Incense Vessel of the Ming Dynasty.



A Pair of Bronze Horses of Unknown Antiquity.

SOME REMARKABLE OLD CHINESE BRONZES.

RECENTLY PATENTED INVENTIONS.

Electrical Devices.

SOCKET FOR ELECTRIC LAMPS.—J. A. MEBANE, South Boston, Va. The object of the inventor is to provide an improved socket for incandescent lamps in which socket-screws are wholly dispensed with, the separate parts being adapted to be easily and quickly connected and disconnected and the electrical connections being made in such manner that the socket may be produced at much less cost than those of usual construction. The casing of the socket is likewise so constructed that its two parts are held together detachably by means of a spring-clamp without aid of screws.

REGULATOR FOR ALTERNATING CURRENTS.—E. L. HANEY, Nashville, Tenn. In the present patent the invention has reference to regulators for alternating currents; and the improvement consists, essentially, of a transformer of a special construction, together with means for automatically adjusting the transformer to suit the variations in the current.

Of Interest to Farmers.

HARVESTER-REEL.—C. O. WYMAN, Anoka, Minn. The primary object of the invention is to provide a reel which may be readily folded into compact form for shipment, and which may also be freely adjusted in all directions when in use for the double purpose of adapting the reel to the condition of the grain and lay of the land while operating, and for holding the reel closely against the body of the harvester when the same is being drawn to and from the field.

STOREHOUSE FOR GRAIN OR THE LIKE.—R. C. ROACH, Hutchinson, Kan. In this structure grain or like material may be stored or kept in a state of preservation for an indefinite length of time. The inventor provides simplified and effective means whereby grain may be elevated above and deposited within the structure and provides means whereby the delivery of grain from the storehouse may be readily effected in any quantity, for shipment or transfer thereof or for other purposes. The structure may be rapidly filled or emptied.

FRUIT-PICKER.—I. CARMAN, St. Remy, N. Y. This invention relates to a device intended especially for picking strawberries, and by its means a person may go through a field or garden and conveniently cut the stems of the berries which will thereupon fall into a receptacle provided for them, this receptacle forming part of the fruit-picker, and when the receptacle is full the berries may be dumped into a box for shipment.

COTTON-COMPRESSOR.—A. T. SNODGRASS, Patterson, La. The objects of this inventor are, first, to provide a compressor in which all strains are at or near the bottom; second, to so arrange all levers and toggle-joints in such a manner that all strains will be exerted directly in the direction which will develop the most power to the upward motion of the movable platen; third, to construct a compressor whose leverage is so arranged as to develop the required power (say two thousand tons) through the means of a comparatively small actuating-cylinder.

Of General Interest.

TRAP.—A. L. FUQUA, Durham, N. C. The present invention refers to a trap of such organization as will admit of contents being drained by an operation which, in addition to draining the trap, cuts off completely its connection with the sewer, so that the device may be used either as a trap or stop-cock. This arrangement dispenses at will with the usual stopper or stop-cock of basins, tubs, and the like, and empties the trap to prevent freezing of the water seal and without exposing the apartments to the danger and nuisance of gases escaping from the sewer.

TONGS.—J. G. WINGER, Grand Valley, Pa. The device comprises a handle on which two peculiarly-arranged jaws are mounted, the structure being such that upon operating the handle the jaws may be caused to move toward or from the object being gripped, and these jaws coacting with a gripper on the handle serve securely to hold the pipe, casing-collar, or other part against turning movements in either direction.

BRIDLE-BIT.—T. MILLIGAN, Fortuna, Cal. In the present patent the invention has reference to improvements in bridle-bits for horses, the inventor's object being the provision of a novel form of bit particularly adapted for controlling fractious horses with comparatively very little effort on the part of the driver.

WIRE-STRETCHING DEVICE.—W. D. MILLER, Saco, Mont. Mr. Miller's object in this invention is to provide novel details of construction for a wire-stretcher that are simple, practical, and inexpensive and that afford means for conveniently stretching and temporarily holding a fence-wire alongside of a post for its convenient attachment thereon.

NIGHT-LAMP.—R. P. GIBBS, New York, N. Y. The prime feature of the invention which relates particularly to a night lamp of that class which is adapted to contain oil which is burned through the medium of a wick floated on the surface of the oil, lies in the adaptation to such a lamp of the shell of a fish or other shell-bearing animal, such shell being made to contain oil, so that light is shed through the shell with the various colors thereof. This gives a very beautiful effect.

LEATHER-POLISHING ROLL.—W. H. GERRITY, New York, N. Y. The roll is formed of a number of disks secured side by side upon an axial shaft or other means, the disks being provided with spiral ribs, said disks being molded with a sunken portion inward from the peripheral portion, thus leaving out a relatively narrow belt to be ground away to fit the disks together, the disks being formed on a slight bevel, so that their meeting surfaces will lie diagonally of axis of the roller, and thus when roller is in operation its action covers any marks left by the meeting surfaces of disks, which marks might otherwise appear in case disks were placed on the shaft in true transverse plane.

TERRET-RING FOR HARNESS.—M. BRENNAHAN, Colby, and L. H. GAFFNEY, Greenbay, Wis. The object of this improvement is to provide means for positively controlling a horse or a team of horses, so that the animal or animals will be prevented from pulling forward upon the driving-reins beyond a predetermined limit and also to restrain them from tossing their heads upward or sidewise in attempts to bite each other while standing or in motion.

FILE-HOLDER.—C. ARMIJO, Lascruces, New Mex. In this instance the invention has reference to file-holders, the inventor's object being the provision of a device for holding files of various kinds, and especially those designed for filing away canceled checks which are to be kept for a short time only and are to be taken out at intervals.

Machines and Mechanical Devices.

HOISTING DEVICE.—R. MCGAHEY, Walla Walla, Wash. The inventor has for his object the provision of novel details of construction for a device that adapt it for the convenient service for the elevation of material of different kinds and that render it especially well adapted for the hoisting of grain in bags and the piling of such packages of material in tiers for compact stowage in a warehouse in an expeditious and safe manner and effect the lowering and transfer of such material to a wagon or car.

WASHING-MACHINE.—D. B. D. BLAKE and W. F. BLAKE, Chicago, Ill. This invention relates to washing-machines, and more particularly to that type in which the tub is sustained for oscillatory movement upon a suitable supporting structure. The principal object is to provide a simple, inexpensive, and durable machine in which improved devices are provided for automatically returning the tub to its normal position after each movement thereof.

MACHINE FOR FORMING WIRE LOOPS.—H. P. WILSON, New York, N. Y. Mr. Wilson's invention pertains to improvements in machines for forming loops or eyes on the ends of wires—such, for instance, as wire bale-ties—an object being to provide a machine of this character by means of which the loops on wire ends may be rapidly formed and having means for automatically stopping the machine after forming the loops on a predetermined number of wires to form a bundle.

APPARATUS FOR RAISING LIQUIDS.—O. H. STAKEMANN, Christiansted, St. Croix Island, Danish West Indies. The apparatus is especially designed for use in raising water from wells or other sources where ordinary pumps cannot be worked by windmills and other power not available at the particular point at which the wells are situated. It will be especially valuable where other power is already located at some distance from the source of water, as that can be used for compressing the air employed in this apparatus.

Prime Movers and Their Accessories.

ROTARY BOILER.—H. BROWN, 4 Herne Hill Mansions, Herne Hill, London, S. E., England. Mr. Brown's intention is to provide a boiler in which thorough circulation and agitation of water in the tubes is insured and burning or overheating of the tubes is prevented. The invention consists in mounting a tubulous boiler on trunnions and then rotating said boiler about its longitudinal axis over a furnace, the feed-water and the steam generated being led, respectively, to and from the boiler through a trunnion or trunnions.

PACKING.—C. G. HOLMBERG, Woonsocket, S. D. The object of the invention is to provide a packing, more especially designed for packing the pistons of engines—preferably such, for instance, as shown and described in the Letters Patent of the United States formerly granted to Mr. Holmberg—the packing being simple, easily applied, and arranged to yield in every direction to prevent leakage of the motive agent without creating undue friction.

Railways and Their Accessories.

REGISTER-ACTUATING MECHANISM.—W. W. JOHNSON, Memphis, Tenn. In this patent the invention refers to registers, and more particularly to the actuating mechanism thereof. The principal object is to provide an improved form of actuating-mechanism for registers used upon tram-cars and other public vehicles and also suitable for use in connection with all inclosures where it is desirable to register the entries of persons therein.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of the paper.

Business and Personal Wants.

READ THIS COLUMN CAREFULLY.—You will find inquiries for certain classes of articles numbered in consecutive order. If you manufacture these goods write us at once and we will send you the name and address of the party desiring the information. In every case it is necessary to give the number of the inquiry.

MUNN & CO.

Marine Iron Works. Chicago. Catalogue free.

Inquiry No. 6689.—For manufacturers of crates and boxes the size of "Octagon Soap" box.

"U. S." Metal Polish. Indianapolis. Samples free.

Inquiry No. 6690.—For manufacturers of lead pencils with name and address stamped on it for advertising purposes.

Perforated Metals. Harrington & King Perforating Co., Chicago.

Inquiry No. 6691.—Wanted, vapor bath cabinet with complete apparatus, and having outside heater.

Adding, multiplying and dividing machine, all in one. Felt & Tarrant Mfg. Co., Chicago.

Inquiry No. 6692.—For manufacturers of improved machinery for manufacture of peat.

Commercially pure nickel tube, manufactured by The Standard Welding Co., Cleveland, O.

Inquiry No. 6693.—Wanted, catalogue and information about broom manufacture, the materials, tools and machinery used; also address of manufacturers of broom-making machinery.

Sawmill machinery and outfits manufactured by the Lane Mfg. Co., Box 15, Montpelier, Vt.

Inquiry No. 6694.—For names of a few large manufacturers of park benches or settees.

Wanted.—Schemes to use in connection with cash grocery business. Farmers' Supply Co., Iona, Mich.

Inquiry No. 6695.—For manufacturers of atmospheric turbines used in boring artesian wells.

Valuable Patent Rights For Sale.—A fly and mosquito gun. Rasmus Petersen, R.F.D., Asbury Park, N. J.

Inquiry No. 6696.—Wanted, address of a cotton candy machine company.

The celebrated "Hornsby-Akroyd" Patent Safety Oil Engine is built by the De La Vergne Machine Company, Foot of East 138th Street, New York.

Inquiry No. 6697.—For manufacturers of small clutch pulley that makes one revolution then stops.

Gut strings for Lawn Tennis, Musical Instruments, and other purposes made by P. F. Turner, 46th Street and Packers Avenue, Chicago, Ill.

Inquiry No. 6698.—For manufacturers of cement plaster machinery.

In buying or selling patents money may be saved and time gained by writing Chas. A. Scott, 719 Mutua Life Building, Buffalo, New York.

Inquiry No. 6699.—For manufacturers of small rubber device for tobacco bags called "Squeeze-it."

We Manufacture on Contract anything in light Hardware. Write us for estimates. Edmonds-Metsel Mfg. Co., 143-153 South Jefferson Street, Chicago.

Inquiry No. 6700.—For manufacturers making a machine that will gum paper in rolls.

We manufacture iron and steel forgings, from twenty pounds to twenty-five tons. Crank shafts of all varieties. Erie Forge Company, Erie, Pa.

Inquiry No. 6701.—For manufacturers of a darning needle with point ¼ inch long and no eye.

Have you found a manufacturer for your invention? Write now and send samples. New York Die and Model Works, 408 Pearl Street, New York.

Inquiry No. 6702.—For manufacturers of bicycle balls or gears and castings for same.

We manufacture anything in metal. Patented articles, metal stamping, dies, screw mach. work, etc. Metal Novelty Works, 45 Canal Street, Chicago.

Inquiry No. 6703.—For manufacturers of small hand machines for combing horses' hair to be used in mattresses.

The SCIENTIFIC AMERICAN SUPPLEMENT is publishing a practical series of illustrated articles on experimental electro-chemistry by *N. Monroe Hopkins*.

Inquiry No. 6704.—For manufacturers of isinglass, such as is used for stoves.

General Utilities Company, 290 Broadway, New York, offers unusual facilities for placing inventions and devices of merit before the public. Correspondence invited.

Inquiry No. 6705.—For manufacturers of "Pressure Tank" water works system.

WANTED.—Colonial silverware. Any one wishing to sell any authentic silver made in this country during the eighteenth century, please communicate with C. A. M., Box 773, New York.

Inquiry No. 6706.—Wanted, information concerning cost of equipping a plant for electric lighting and power purposes, providing current enough for town of 25,000 or 30,000 inhabitants.

Manufacturers of patent articles, dies, metal stamping, screw machine work, hardware specialties, machinery and tools. Quadriga Manufacturing Company, 18 South Canal Street, Chicago.

Inquiry No. 6707.—For manufacturers of machines run by electricity or otherwise, for sand-papering floors laid in place in a building.

You can rent a well equipped private laboratory by day, week or month from Electrical Testing Laboratories. 548 East 80th Street, New York. Absolute privacy. Ask for terms and facilities.

Inquiry No. 6708.—For manufacturers of accordion plaiting machines.

Space with power, heat, light and machinery, if desired, in a large New England manufacturing concern, having more room than is necessary for their business. Address Box No. 407, Providence, R. I.

Inquiry No. 6709.—For manufacturer of article called "Squeese it," marked patented November 28, 1905.

WANTED.—Representative to sell our spinning, weaving and batting machinery, by oldest firm in France and Germany. Grand prize awarded Paris Exposition. Address Stoeg, 363 William Street, Buffalo.

Inquiry No. 6710.—Wanted, formula for making railroad torpedoes for placing on rail as a danger signal for approaching trains.

A Reliable Manufacturing Institution solicits the correspondence of parties desiring to sell patents of any *useful mechanical article* which could be manufactured and sold in conjunction with the Mill Supply and Belting business. F. Banfville Co., Pearl St., Grand Rapids, Mich.

Inquiry No. 6711.—For Eastern and Western manufacturers of barber's chairs, supplies and plate glass mirrors.

Notes and Queries.

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.
References to former articles or answers should give date of paper and page or number of question.
Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.
Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.
Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.
Scientific American Supplements referred to may be had at the office. Price 10 cents each.
Books referred to promptly supplied on receipt of price.
Minerals sent for examination should be distinctly marked or labeled.

(9598) A. W. asks: Please give the formula for estimating cost per hour for a 16-candle-power incandescent lamp on a 110-volt, 5-ampere circuit, rate 15 cents per kilowatt per month. A. A 16-candle-power lamp may be taken to use 55 watts per hour. Multiply this number by the number of hours it is in use per month and divide by 1,000, and you will have the kilowatts used in a month.

(9599) G. G. K. asks: Would be pleased to have you answer this question: I wish to protect a house from lightning: house is roofed with shingles. It has a metal ridge board on the peak made from galvanized sheet steel strips 4 feet long and 11 inches wide, each strip extending over the last strip a few inches and all nailed to the roof. By placing points on this metallic ridge board and giving a good ground connection at two places so as to make a complete circuit over the building, would this give good protection from lightning? Please answer in Notes and Queries. A. The sheet metal ridge of your roof will be a very good starting point for a lightning rod. We should advise that you use heavy galvanized telegraph wire for the ground lines and run them down the edges of the roof so as to have all edges provided with a wire. Then make a good earth connection and you will be as well protected as possible. Points may be put on the ridge also.

(9600) T. W. A. asks: I have been making a dry battery which when it is just finished shows from 22 to 26 amperes, but after standing a while, say from 5 to 7 days, will only show 5 or 6 amperes. What is the cause of it, and how can I remedy it? The cell is of the ordinary size, 22 x 6 inches, made of a zinc can lined with paper soaked in a solution of water, sulphuric acid, and bichromate of potash, carbon in the center of can surrounded by a mixture of coke dust, bichromate of potash, sal-ammoniac, graphite, sulphuric acid, and water, all packed in tight and sealed at the top with tar. Would you kindly tell me how, if possible, it can be made so it will not lose its strength so soon? A. The cell you describe is not a dry cell at all. It polarizes and cannot be sealed up and left to itself. The bichromate of potash and the sulphuric acid should be left out, and the cell made to conform to the instructions for making dry cells. The sulphuric acid will act continuously on the zinc whether the cell is in use or not. A dry cell is one which may be left on open circuit without deterioration. Yours cannot be left in that way. We can furnish you full and accurate directions for making dry cells in the SCIENTIFIC AMERICAN SUPPLEMENT Nos. 1363 and 1387, price ten cents each.

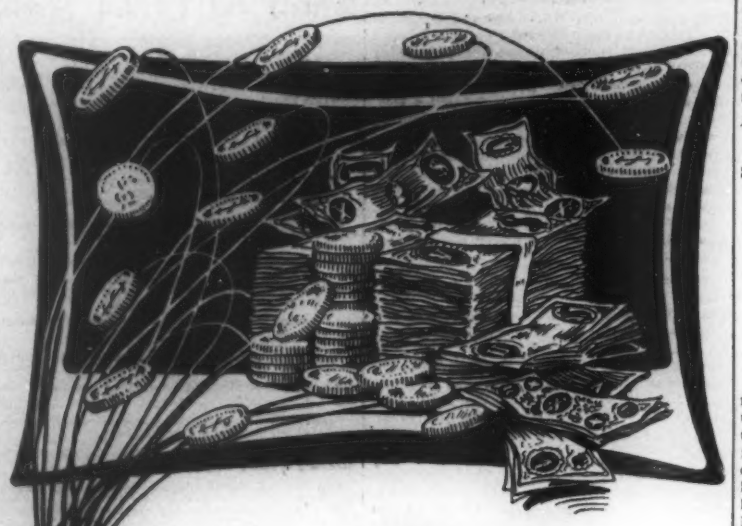
(9601) A. S. asks: If a cubic hole were dug in the center of our earth about 8 x 8 x 8 feet, and a man could be in the hole, how would he know whether his head were up or down, or he were lying down or standing upright? A. If a man were in a hole at the center of the earth he would not know which direction was up or down; there would be no such thing as direction. This would be the case, without reference to the size of the hole, even if it were thousands of miles across. If the earth were hollow, a body anywhere in the hollow would be equally attracted in all directions and would lose the sensation of weight or gravitation. All directions would be the same to him.

(9602) M. F. F. asks: 1. How can you lacquer brass, and what is the preparation used to lacquer with? A. Lacquer is prepared from a nice grade of shellac, better from seed lac, by dissolving it in alcohol and adding some other substance to color or harden it. The article must be perfectly clean and should be warmed. The lacquer is applied with a brush. Full and detailed instructions may be found in our "Scientific American Cyclopedia of Receipts," which we send for $5. 2. A friend works in a telegraph office and he says his relays are wound in the same direction on both magnets and a telegraph sounder is wound differently. I think the relay is wound in different directions. Who is right? A. The direction of winding the magnets of a relay is of no consequence. They must, however, be connected so that the current circulates in one direction on one spool and in the other di-

rection through the other spool, so that one pole is plus at the armature and the other is minus. The same is true of a sounder. 3. I made a wireless telegraph and it works very well except when the tapper should knock the filings apart, and this it will not do. Am I using too much current, or what is the matter? A. Perhaps your coherer needs to be tapped harder to knock the filings apart. Perhaps the ends of the plugs are too near together so that the filings are held too tight. You can easily find if less current will make it work better. 4. How many gallons of water will flow out of a pipe in one day with a pressure of 108 pounds and the hole in the pipe 1-16 inch in diameter? A. The theoretical solution gives about one gallon a minute for the flow from the hole in the water pipe you describe. So much depends upon the thickness of the pipe and the condition of the edges of the hole, etc., that this may be far from the real efflux. This can only be determined with correctness by experiment.

(9603) M. W. H. asks: 1. What is the philosophy of salt causing ice to freeze and unite in summer (as in case of making ice-cream), and causing ice and snow to melt in winter? A. Salt does not cause ice to freeze in summer and melt in winter. That is very loose thinking. The ice and salt in the freezer melt at any time of the year. The cream in the inner can freezes because the heat which melts the ice in the outer box is taken from the cream in the inner can. The ice cannot get heat to melt itself from the outer air because the box in which it is is of wood, which is a non-conductor of heat. The inner can is of metal and so is a conductor of heat. The cream furnishes heat to the ice and is cooled and frozen by the process. Ice and salt will melt in the open air by taking heat from the air at any temperature above 7 deg. F. below zero. Below that temperature they will not melt. 2. Why does frost penetrate solid ground so much deeper (in the same locality) than it does loose, porous ground? A. Solid ground freezes better than porous ground because the porous earth contains air. Air is one of the very best non-conductors of heat, and keeps the heat in the earth. 3. Why does frost penetrate a wall 12 inches thick (solid) sooner than the same thickness of wall with an open space in it, say, for instance, 6-inch wall, 3-inch space, then 6-inch wall, there being no way to moderate the temperature between the two 6-inch walls—or even a 12-inch wall with a 2-inch air space in it? A. The air space in a wall acts just as the air spaces in the porous ground do in the last question. It prevents heat from passing, and thus houses are built with air spaces in the walls to keep them cool in summer and warm in winter. Double windows are used in cold regions for the same purpose. 4. Would the explosion of a compressed-air tank be as dangerous to life and limb as other explosions, say, for instance, steam (outside of being scalded) or other explosives such as powder or dynamite? If there be a difference what is the nature of it? A. Air at the same pressure as dynamite will produce as destructive effects as dynamite. It is difficult to imagine any method by which this can be brought about. 5. As everything in nature has a cause, what causes the wind to blow (hard or easy); also what causes it to change sometimes half a dozen times a day, apparently in the same temperature (hot or cold)? A. Wind is produced by the heat of the sun, and always blows from a place of higher barometric pressure to one of lower pressure. This place may be in the next field in a summer day, and it may be hundreds of miles away. The wind rarely travels in a straight line for any considerable distance, but swerves and changes its direction as you state. 6. At what height in a heated room is the most stagnant air, consequently the most unhealthy and germ-bearing atmosphere? A. No height can be given for the worst air in a room unless it be at the ceiling above. Currents quickly diffuse the bad air to all parts of a room.

(9604) D. F. F. asks: I would like to know, through your query column, how the degrees on the scale of a Baume hydrometer are determined? On an ordinarily marked hydrometer the specific gravity of the liquid under examination may be read directly from the scale; but on a Baume hydrometer the degrees do not give, directly, the specific gravity of the liquid. Now, what I wish to know is, on what are the degrees of the scale based? In other words, what is the zero point, and what other point is used, and how is it found, for determining the length of a degree? A. There are two Baume hydrometers, one for light liquids and the other for heavy liquids. Each has its own scale and the degrees are not the same in both scales. The zero point of the one for heavy liquids is near the top of the tube, and is the point to which it sinks in pure water. It is then placed in a solution of 15 parts salt and 85 parts water; the point to which it sinks is called 15 degrees, and one degree is found from this. The rest of the scale is simply a scale of equal parts in terms of this degree. The hydrometer for light liquids is placed in pure water and marked, and then in a solution of 10 parts salt and 90 parts water, and one degree is found from this. The point to which it sinks in salt and water is zero. The rest of the scale is graduated from the bottom upward, in terms of this degree. The entire scale is arbitrary and has no relation to a specific gravity scale. It is only by means of a table that one scale can be converted into the other. Nor has a Baume degree the same significance in one part of the scale of the same instrument as it has in another part, due to the variable immersion of the instrument.



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SPECIES AND VARIETIES. Their Origin by Mutation. Lectures delivered at the University of California by Hugo de Vries, Professor of Botany in the University of Amsterdam. Edited by Daniel Trembly MacDougal, Assistant Director of the New York Botanical Garden. Chicago: The Open Court Publishing Company. London: Kegan Paul, Trench, Trübner & Co., Ltd. Pp. xxiii; 830; 8vo., cloth, gilt top. Price, postpaid, $5.

Prof. De Vries may well be regarded as the foremost advocate of experimental evolution, the man, moreover, who gave us the mutation theory of organic evolution. The volume before us is a splendid scientific plea for the experimental study of organic life. Working hand in hand with such investigators as Johanssen, Overton, Wilson, Loeb, Delage, and Davenport, all of whom have experimented with life in some form or other. Prof. De Vries has confined himself to the study of those forms of plants that suddenly make their appearance from time to time. It was his good fortune to discover a wild plant (Lamarck's evening primrose) which may still be considered in a condition of mutability. At frequent intervals it is observed to produce an entirely new and permanent species, although the stock itself is not altered by the process, nor even noticeably diminished. This is, perhaps, the most striking instance of experimental mutation to which Prof. De Vries can point, an instance, moreover, which shows that sudden sports are the prevailing rule, and probably the exclusive manner of originating new varieties. Mutation, of course, cannot be assumed to be a special feature of evening primroses. They must occur elsewhere, and these must be sought. The œnothera was one of a lot of nearly one hundred species tested as to their constancy. It proved to be the only changeable form among them. By testing one hundred species of the same forms, it seems probable that one or two instances of mutability may be detected. The chief object of Prof. De Vries's inquiry has naturally been the study of the mutable strain itself. Some of its seeds yield new species, while others are more conservative. It is probable that the degree of mutability, or in other words, the yield of mutating seeds, is more or less dependent upon external life conditions.

THE ELEMENTS OF PLANE AND SOLID ANALYTICAL GEOMETRY. By Albert L. Candy, Ph.D. Boston: D. C. Heath & Co., 1904. 12mo.; pp. 247. Price, $1.50.

The author has recognized the interdependence of algebra, geometry, analytics, and calculus in mathematics, and the present work is prepared with this idea in mind, so that the student is led step by step up to the higher branches. It is a well-known fact that calculus proves a stumbling block to many students, because they have not been thoroughly trained in analytic geometry and shown its connection therewith. To avoid this, the present work is treated in an original manner, matter not ordinarily found in text books being introduced. The problems are dealt with in a very graphical manner and very freely explained.

HOMOPHONIC VOCABULARY IN TEN LANGUAGES. By Charles B. Waite, A.M. Chicago: C. V. Waite & Co., 1904. 8vo.; pp. 162. Price, $2.

In the preparation of this work, which is the result of more than three years' labor, Mr. Waite has taken the first step toward a universal language. Starting with ten languages, namely, English, French, Spanish, Portuguese, Italian, German, Dutch, Danish Norwegian, Swedish, and Russian, the author expected to find but a few hundred words which had similar sounds and significance in each tongue. He has finally been able, however, to find more than two thousand words, nearly all of them in common use. This list, which has been carefully revised and corrected, is intended to serve as a basis for common root words, upon which to found a common language for the Indo-Germanic family. The words are arranged in alphabetical order, in ten columns, occupying two pages each. An explanatory introductory article is printed in all ten languages, as is also the title page. A special feature of the volume is a complete family tree of the Indo-Germanic family of languages. The book is interesting as showing the possibilities in the way of a universal language.

BOILER-ROOM CHART. By George L. Fowler. New York: Norman W. Henley Publishing Company, 1904. Size 14 x 28 inches. Price, 25 cents.

This chart, which is intended to show at a glance any part of a boiler-room equipment, is a large drawing in isometric perspective, illustrating water-tube boilers, ordinary grates, and mechanical stokers, feed-water heaters, and pumps. The various parts of the different mechanisms are shown broken away,

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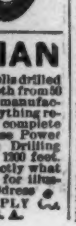

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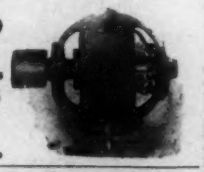

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so that the internal construction may be readily seen. Reference numbers of the different parts refer to the list of these parts at the side of the chart.

AMERICAN TOOL MAKING AND INTERCHANGEABLE MANUFACTURING. By Joseph V. Woodworth. New York: The Norman W. Henley Publishing Company, 1904. 8vo.; pp. 400; 970 illustrations. Price, $4.

This work is intended for the practical draftsman, machinist, and tool maker. In it the author has endeavored to give accurate and concise descriptions of the fundamental principles, methods, and processes by which the greatest accuracy and highest efficiency may be attained in the production of repetition parts in metal at the minimum of cost. The construction of a large number of special tools and their use is gone into fully, and complete directions for making various tools, jigs, etc., are given. Tools for working various metals are described in detail, as are all the processes by which these various metals are worked. The book is very complete, being illustrated by over 600 drawings, and it should be found in the library of every machinist and tool maker.

THE MECHANICAL ENGINEERING OF COLLIERIES. By T. Campbell Futers. London: The Chichester Press, 1905. 4to.; pp. 128. Price, $3.

The present book is the first of two volumes on this subject, and it deals with boring, sinking, surface arrangements, headgears, and shafts. The book gives all the latest information of value to the colliery engineer, and it is profusely illustrated with numerous half-tone plates and line drawings to the total number of 294. All the most recent improvements—both electrical and mechanical—in mine-boring and shaft-sinking machinery are described, and the work will no doubt be highly appreciated by all mining men.

ELEMENTARY COURSE IN MECHANICAL DRAWING. Part I. By Arthur W. Chase, B.S. Chicago: Howland Speakman, 1904. Size, 7 x 9 inches; pp. 189; 97 illustrations. Price, $1.50.

This book is a simple, untechnical work on the subject of mechanical drawing. All plates required in the course are omitted from the book, thus preventing the copying of such plates by the student. The course contains a brief drill of a few fundamental geometrical problems. Orthographic projection is studied from models, thus giving the student a concrete instead of an abstract conception. Specifications are given for each problem, so that the pupil may have a drill similar to what he would experience in practical work.

INDEX OF INVENTIONS

For which Letters Patent of the United States were issued for the Week Ending March 28, 1905

AND EACH BEARING THAT DATE

[See note at end of list about copies of these patents.]

Advertising coloring materials, paints, etc., method of and device for, J. F. Gould	786,210
Advertising device, Farnsworth & Martin	786,018
Aeroplane, A. P. Criswell	786,717
Aeroplane covering, I. Lancaster	785,740
Air and gas motor, compressed, M. E. Clark	785,713
Air brake control, F. B. Corey	786,008
Air brake system, automatic, F. B. Corey	786,007
Air compressor, hydraulic, C. R. Jones	785,889
Air separator, C. H. Lane	785,811
Alimentary composition, B. Gollwitzer	786,111
Aluminium or other metals, extracting, H. S. Blackmore	786,244
Amusement apparatus, S. Miyata	786,229
Animal colics or gripes, apparatus for treating, A. Hepnar	786,215
Animal dipping apparatus, E. W. Bennett	786,089
Antiseptic mats, manufacture of sanitary, J. P. Sutor	785,838
Armatures, commutating device for alternating current machine, M. Deri	786,010
Awl, sewing, M. R. Botkin	786,009
Awning and frame, folding, J. A. Poltock	785,915
Axle skein, G. U. Rounds	786,159
Bag fastener, A. F. Fuller	785,870
Bale tie, E. L. Pence	786,147
Ball, appliance for playing table foot, M. Gillett	786,206
Bandage dressings, preparing, M. Cohn	786,004
Bar fixture, C. C. Finch	785,942
Bath brush and connection, spray, A. W. Nicholls	785,824
Bathing apparatus, C. H. C. Jordan	786,127
Bearing, roller, W. C. Fownes, Jr.	785,944
Bedstead construction, A. Taylor	786,173
Belt stud tool, J. Stocker	786,065
Binder frame, W. J. Watters	785,924
Binder, loose leaf, P. Montgomery	785,750
Binder, temporary, F. L. Nold	785,911
Bit, See Drill bit.	
Blotter, A. N. Sill	785,836
Blower, H. E. Parson	786,234
Bobbin carrier, G. Dingendahl	785,718
Boiler flue scraper, W. G. Bolus	786,092
Boiler tube tightening device, F. J. E. Johansson	785,888
Boiler tubes, tool for operating upon, J. L. Smith	786,064
Book, scrap, A. M. Pettengill	786,235
Boron by electrolysis, production of, Lyons & Broadwell	785,902
Bottle, R. J. Modespacher	786,134
Bottle corks or like stoppers, means for securing, J. J. Chavasse	785,859
Bottle or the like receptacle, milk, F. Hammond	786,212
Branding iron, self heating, Parker & Garnett	785,827
Brick or tile cutting machine, C. R. Codding	786,003
Bricks from coal or coke refuse, manufacturing, J. Hammerschlag et al	786,028
Broom handle attachment, L. Shaffner	786,160
Brooms into bundles, device for assembling, A. P. Longdon	786,228
Buckle, suspender, M. L. Rothschild	785,920
Buggy top brace, P. W. & D. D. Moyer	786,138, 786,139
Building block, J. F. Dunham	786,250
Burner, H. K. Hess	786,123
Butter cutter, C. P. Ross	785,978
Butter tray, A. C. Hummer	785,952

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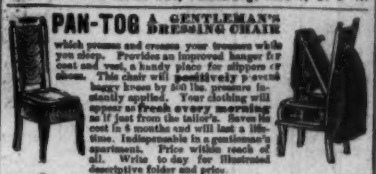

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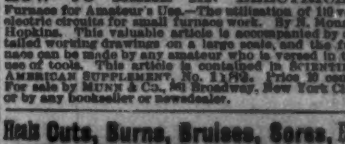

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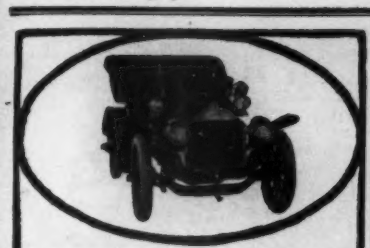

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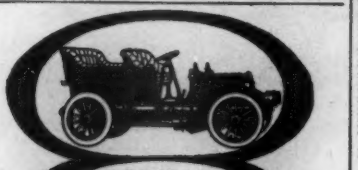

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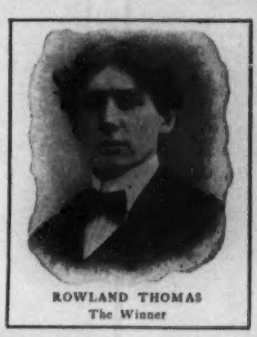

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